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IN ALL ITS APPLICATIONS TO

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THE MONO CHARACTER OF ETHYLEN AND OTHER POLYAMINES.

By S. E. PHILLIPS.

OWING to inveterate preconceptions, it often happens that truth requires a constant reiteration. We have on many occasions referred to the mono character of these amines, and made a formal enunciation, in an enquiry as to certain morphia polymerides (CHEMICAL NEWS, vol. xxxi., p. 47).

Dr. Wright, however, defends the position occupied by Hofmann, Odling, and others in the following terms:—

“As a rule, the maximum combining power of such bodies is usually equal to the number of N symbols in their rational formulæ, although a lesser acid-combining power may be sometimes manifested. Thus, quinine can be either mono- or di-acid; ethylen-diamine and analogously-constituted bodies are di-acid (sometimes mono-acid also); the poly-ethylen triamines can be mono-, di-, or tri-acid, as can also rosanilin and its derivatives, or its homologues; the only poly-ethylen tetra-amines exhibit a maximum acid-combining power of four, and so on.”

As quinine is referred, we give the following, from Lowig:—

The sulphate, $C_{40}H_{25}O_4N_2O + SO_3$.
 „ acid sulphate, $HO, SO_3 + C_{40}H_{25}O_4N_2O + SO_3$.
 „ chloride, $C_{40}H_{25}O_4N_2Cl$.
 „ platinate, $C_{40}H_{25}O_4N_2Cl + PtCl_2$.

The picture of sulphate of potash differs in no particular whatever! In both cases we have the sulphate, the acid sulphate (the di-, or double salt), and we may have the anhydrous di-salt of either quinine or potash.

This really is not a question of what *may be*, but of what the facts actually are as derived from modern authorities holding the same views with Dr. Wright.

It is in no way necessary to deny that rosanilin may be made to take up two or three atoms of acid, but I never saw it notated with more than one; and it is expressly stated to be “a monatomic triamine!”

I have excluded, *pro tem.*, di-pyridine and the morphia polymerides as possibly exceptional and fair subjects for enquiry; yet it is not a little curious that, as the morphia and di-morphia of Watts are both mono and normal, so, also, the same can be observed in the case of pyridine. The platina and platinosa pyridines of Reynolds have very complex notations, but they contain the following normal constituents:—

Platino-pyridine, $C_{10}H_3H_2PtNCl + PtCl$.
 Platoso-pyridine, $(C_{10}H_3)_2H_4PtN_2Cl + PtCl$.

Schützenberger also obtains a very complex series, which may be simplified as follows, notating oxethyl as Ae:—

The amine, Ae_3PtP_3Cl .
 „ di-amine, $Ae_6PtP_2Cl + PtCl$.
 „ tri-amine, $Ae_3Pt_2H_5P_3Cl + PtCl$ ($- = PN_2$).
 „ tetra-amine, $Ae_6Pt_2H_5P_4Cl +$ ($- = T_2N_2$).

A recent research describes oxethyl, acetyl, allophanic acid—

The type, $(CO)_4H_3N_2O + HO$.
 „ acid, $(CO)_4AeAcHN_2O + HO$.
 „ potash salt, $(CO)_4AeAcHN_2O + KO$.

Glyco-cyamaine chloride, $(C_4H_3O_4)CyH_5N_2Cl$.
 „ chloro-platinate, $(C_4H_3O_4)CyH_5N_2Cl + PtCl_2$.
 Glyco-cyamidine „ $(C_4H_1O_2)CyH_5N_2Cl + PtCl_2$.

M. Claus obtains—

Glyci-diamine, $(C_6H_5O_2)H_6N_2Cl + PtCl_2$.
 The tri-amine, $(C_6H_5O_2)H_9N_3Cl + PtCl_2$.

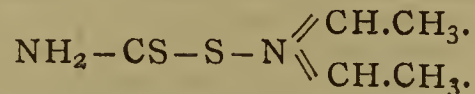
He also obtains some complex sulph-urea and melam derivatives—

The di-amine, $Cy_3H_4N_2S + HS$.
 „ tri-amine, $Cy_6H_7N_3S + HS$.
 „ hexamine, $Cy_9H_9N_6S + HS$!

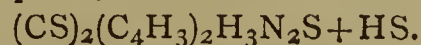
His notation for the tri-amine is peculiar, and wants one more H to satisfy my type. Either I am wrong, a printer's error has crept in, or that eminent physicist has not rightly estimated the analysis. It is given thus:—



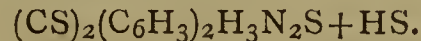
In a recent research, Mulder considers carbothialdine as “diethyliden-ammonium-sulpho-carbamate”—



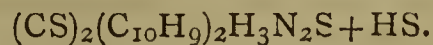
I have long ago notated it, in exact correspondence with that new description, as—



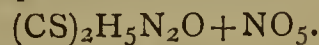
His di-allyliden analogue is—



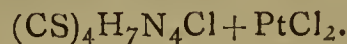
There is also another—



Watts gives a sulph-urea nitrate—



Reynolds, an urea-tetra-amine—



Cyan-benzylamide is $\text{Cy}_3(\text{C}_{14}\text{H}_7)_3\text{H}_3\text{N}_3$.
 The tri-amine, $\text{Cy}_3(\text{C}_{14}\text{H}_7)_3\text{H}_4\text{N}_3\text{Cl} + \text{PtCl}_2$.
 Also a similar body, $\text{Cy}_3(\text{C}_{14}\text{H}_5)_3\text{H}_4\text{N}_3\text{Cl} + \text{PtCl}_2$.

W. Pike has a recent research "On some Homologues of Oxaluric Acid." The substance of that paper is exceedingly good, but very much clouded by diatomic hypothesis and *bizarre* notation. He obtains analogues, rather than homologues, of oxaluric acid.

Oxalyl-urea, $\text{CO}_2\text{GO}_2\text{H}_2\text{N}_2$.
 Oxaluric acid, $(\text{CO})_2(\text{CO})_2\text{H}_3\text{N}_2\text{O} + \text{HO}$ (1).
 Succino-carbamic acid, $(\text{CO})_2\text{C}_8\text{H}_3\text{O}_4\text{H}_4\text{N}_2\text{O} + \text{HO}$ (2).
 Metal salts, $(\text{CO})_2(\text{C}_8\text{H}_3\text{O}_4)\text{H}_4\text{N}_2\text{O} + \text{KO}$.
 Citracon-sulpho-carbamic acid,—
 $(\text{CS})_2(\text{C}_{10}\text{H}_3\text{O}_4)\text{H}_4\text{N}_2\text{O} + \text{HO}$ (3).
 Metal salts, $\text{CS}_2\text{C}_{10}\text{H}_3\text{O}_4\text{H}_4\text{N}_2\text{O} + \text{KO}$.

1. $\begin{cases} \text{CONH—CO—NH}_2. \\ \text{CO.OH.} \end{cases}$
2. $\begin{cases} \text{CH}_2\text{—CO—NH—CO—NH}_2. \\ \text{CH}_2\text{—CO.OH.} \end{cases}$
3. $\begin{cases} \text{C}_3\text{H}_4 < \begin{cases} \text{CO—NH—CS—NH}_2. \\ \text{CO.OH.} \end{cases} \end{cases}$

"The platinum salt of tri-ethyl-ammelide forms beautiful crystalline salts."



M. Cahours gives several phosphines and arsines, of which I only select two, E_3PtPcl and $\text{E}_6\text{PtAs}_2\text{Cl}$.

What is the difference between "di-cyan-diamide" and "di-cyan-diamine"?

Here, as in many other cases, I must urge that the notations of such men as Cahours, Berthollet, and others, better represent the facts than those current in England. In other words, the old notation better agrees with modern descriptions!

The amide, $\text{Cy}_2\text{H}_4\text{N}_2$ $\begin{matrix} \parallel \text{NH} \\ = \text{C—NH} \\ \parallel \text{NH} \end{matrix} > \text{C} = \text{NH}_2$.

The amine, $\text{Cy}_2\text{H}_5\text{N}_2\text{O} + \text{HO} = \text{C} \begin{matrix} \parallel \text{NH} \\ \text{—NH}_2 \\ \backslash \text{NH—CO—NH}_2 \end{matrix}$.

Cyanamide, CyH_2N .
 Di-cyanamide, $\text{Cy}_2\text{H}_4\text{N}_2$.
 Tri-cyanamide, $\text{Cy}_3\text{H}_6\text{N}_3$.
 Mellen, $\text{Cy}_9\text{H}_3\text{N}_4$.
 Melam, $\text{Cy}_6\text{H}_9\text{N}_5$.

Some of these are known in mono-saltic forms, and it is quite safe to infer the same character for all! The tri-amide is known as melamine nitrate, $\text{Cy}_3\text{H}_7\text{N}_3\text{O} + \text{NO}_5$; and a similar acetate and sulphate are given.

In a study of urea derivatives, we have seen that the tri-basic cyanurates are a misnomer and mistake; that they are in no sense ates, or true salts; and that, whenever they become amines, they evince mono characters, quite irrespective of the amount of condensation or of the number of N equivalents in the type. I hope, also, to have traced the true character and genesis of "uric acid." "If right in this, then my myko-melinic acid is the uric acid of the oxalyl series; and both ultimates, by an inverse reaction with 2HO , give corresponding pseudo-acid bodies:—

"Uric acid + $2\text{HO} =$
 $=$ pseudo-uric acid, $\text{CO}_2(\text{C}_6\text{H}_1\text{O}_6)\text{CyH}_5\text{N}_3$.

"Myko-melinic acid + $2\text{HO} =$
 $=$ the pseudo-acid, allantoin, $\text{CO}_2(\text{C}_4\text{H}_1\text{O}_4)\text{CyH}_5\text{N}_3$."

I call this the pseudo-acid simply out of deference to modern usage, but, in truth, neither are acids at all; they are amides, and may have metal substitutions, but such are not true salts.

Our meaning in this will be quite plain by a reference to the following "allantoin" derivatives, which I should notate as follows:—

Allantoin, $\text{CO}_2(\text{C}_4\text{H}_1\text{O}_4)\text{CyH}_5\text{N}_3$.
 Potassium allantoin, $\text{CO}_2(\text{C}_4\text{H}_1\text{O}_4)\text{CyH}_4\text{KN}_3$.
 Allantoic acid, $\text{CO}_2(\text{C}_4\text{H}_1\text{O}_4)\text{CyH}_6\text{N}_3\text{O} + \text{HO}$.
 Allantoin nitrate, $\text{CO}_2(\text{C}_4\text{H}_1\text{O}_4)\text{CyH}_6\text{N}_3\text{O} + \text{NO}_5$.

The second is described as "the potash salt."

In that paper I had occasion to refer to pyruvic acid, and predict a similar series; while writing this, M. Grimaux has artificially produced the pyruvic pseudo-acid; it contains the elements of $\text{CO}_2(\text{C}_6\text{H}_3\text{O}_4)\text{CyH}_5\text{N}_3$.

I have alluded to the confusion and want of discrimination in regard to chloro-acetic acid; I here give two or three illustrations, first premising the general statement that glycolic acid, digested with ammonia, gives a mixture of three or more bodies:—

Glycollamide, $(\text{C}_4\text{H}_3\text{O}_4)\text{H}_2\text{N}$. (1).
 Di-glycollamide, $(\text{C}_4\text{H}_3\text{O}_4)_2\text{HN}$. (2).
 Tri-glycollamide, $(\text{C}_4\text{H}_3\text{O}_4)_3\text{N}$. (3).

Acetic acid similarly gives—

Acetamide, $(\text{C}_4\text{H}_3\text{O}_2)\text{H}_2\text{N}$.
 Di-acetamide, $(\text{C}_4\text{H}_3\text{O}_2)_2\text{HN}$.
 Tri-acetamide, $(\text{C}_4\text{H}_3\text{O}_2)_3\text{N}$.

Aldehyd similarly gives—

Ethenyl-amide, $(\text{C}_4\text{H}_3)\text{H}_2\text{N}$.
 Di-ethenyl-amide, $(\text{C}_4\text{H}_3)_2\text{HN}$.
 Tri-ethenyl-amide, $(\text{C}_4\text{H}_3)_3\text{N}$.

Yet, despite such facts as these, we are taught that ethenyl is a triatomic radical, and that it has the equivalence, or replaces 3H , &c.

Now, it is innocently said that chloracetic acid, with ammonia, gives three amidated acids; the first, called *amido-acetic acid*, or glycollamide (1), and that "amido-tri-glycollic acid" is tribasic.

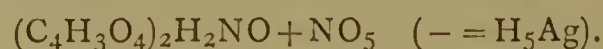
The sad confusion, of which this is but a small specimen, in this direction is very pitiable.

The silver-salt, so-called, is—

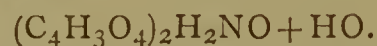


and similar salts are described with $\text{K}_2\text{Ba}_2\text{E}_3$, &c.

"Di-glycollamide nitrate of silver" reveals the true mono character of the salt when such exists—



The hydrate or acid—

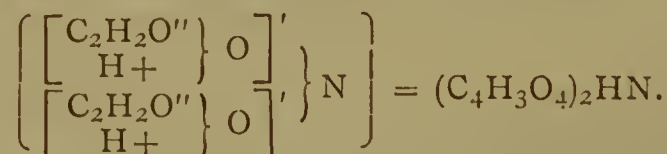


The silver and copper salts of di-ethyliden-lactamidic acid are similar amide substitutions.

Three remarks hereon:—

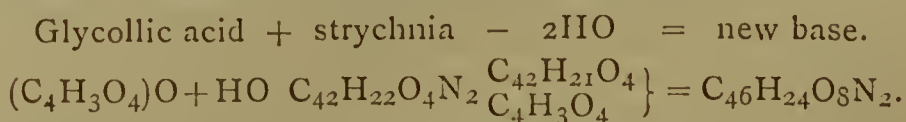
(1). An extended examination will show that all these bodies are simply monatomic, and that all the tri-bases so-called are mistaken amide derivatives.

(2). That the types and names are a complex product of confusion and misapprehension. Naquet's (2) is—

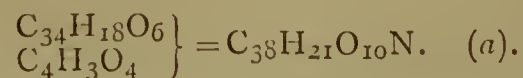


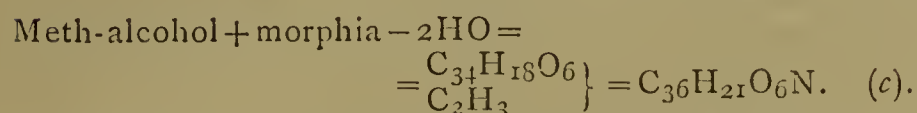
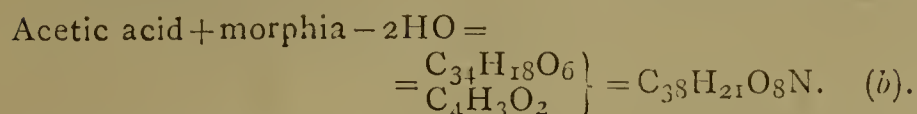
(3). That the chloracetic acid is a mistaken isomeric glycollyl-chloride, one being $\text{C}_4\text{H}_3\text{O}_2\text{O} + \text{HO}$ ($- = \text{H}_2\text{Cl}$), the other $(\text{C}_4\text{H}_3\text{O}_4)\text{Cl}$.

Hence the similar mistake of Dr. P. Romer, who says—"A mixture of *chloracetic acid* with strychnia to 180°C . for several hours gives a new base that he combined with platinic chloride," evidently the equivalent of—



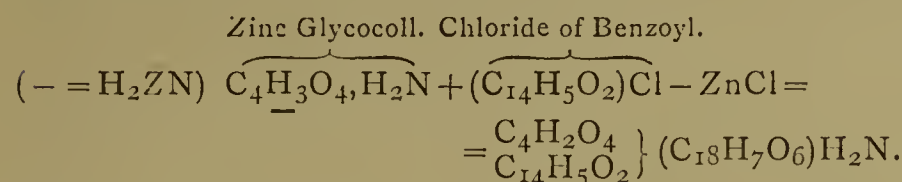
M. Huppert falls into the same error:—"The action of *chloracetic acid* upon morphine gives a new crystalline base"—



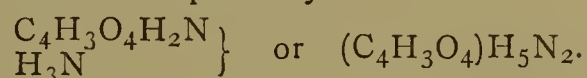


The first is called glycol-morphia. (b) is acetyl-morphia, and would be the same with chloracetic acid. (c) is methyl-morphia, or codeia.

Dr. Armstrong treats of the same subject (p. 265 of his esteemed manual), and the confusion is further confounded by printer's error. His ammonium salt of amido-acetic acid is, in all probability, no salt at all, and the hippuric acid in question is undoubtedly an amide—



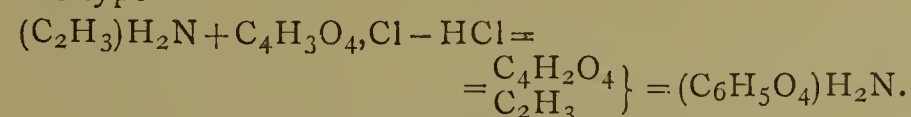
The ammonia salt is probably—



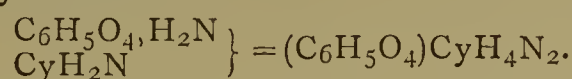
And the proof is plainly involved in the context, "the which amido-acetic acid is found to be in all respects identical with glycocol from hippuric acid."

Again, "the action of *chloracetic acid* on methylamine gives methyl-amido-acetic acid, which is identical with sarkosine, a product derived from creatine;" and here, again, we have a saltic notation for that which is undoubtedly an amide.

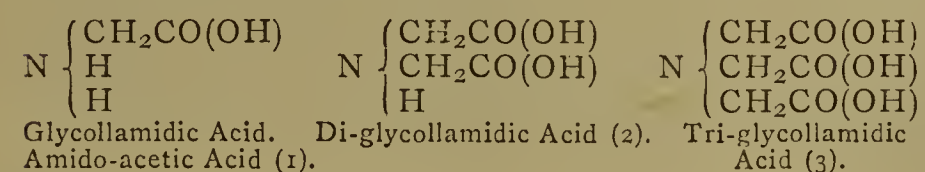
Substitute, for the *chloracetic acid*, glycolyl-chloride, and the context is plain to the meanest capacity, as the action of that body on methylamine would naturally give the type—



Creatin may be produced by the direct union of sarkosine and cyanamide—

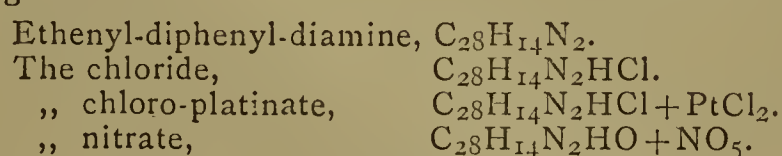


In dealing with single cases it is easy to be misled; and if Dr. Armstrong contended that the amido-acetic acid was $(\text{C}_4\text{H}_1\text{O}_2)\text{H}_3\text{NO} + \text{HO}$, and the ammoniac salt $(\text{C}_4\text{H}_1\text{O}_2)\text{H}_3\text{NO} + \text{AO}$, or the equivalents of such types in diatomic notation, it might be difficult to demur; but even then the difficulties and contradictions would be great. But if we estimate the subject in the light of his triplet, and study the matter in its extended ramifications, the simple truth becomes irresistible.



Notations indicating a mono-, di-, and tri-basic compound, where none such exists.

The ethylen or ethylen bodies form no exception to the general rule—

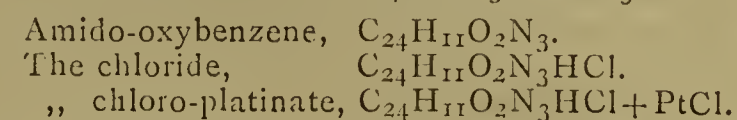
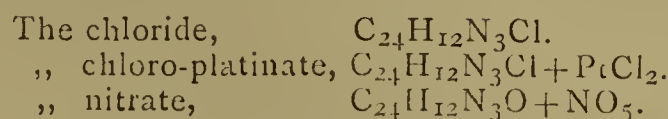


One is tempted to give these in rational formulæ, but, as the cyano tendencies are specially great, and the higher nitrile radicals are a kind of forbidden ground, it may be better to treat the ammonia constituents as one group.

Diazo-benzene nitrate has one atom of NO_5 , the hydrate one HO, and the potash salt one KO.

Diazo-benzamide has the elements of $\text{C}_{14}\text{H}_5\text{O}_2\text{N}_3$, the nitrate $\text{C}_{14}\text{H}_5\text{O}_2\text{N}_3 + \text{NO}_5$.

Amido-benzene is expressly said to be "a monacid base."



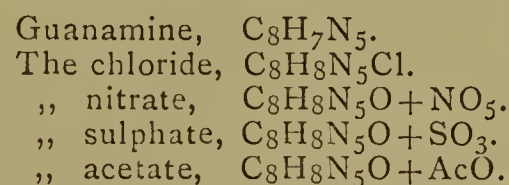
M. Demole has a recent research "On Hydrox-ethylen amines." Of these he gives five varied series, and by their oxalates, sulphates, chloro-platinates, &c., they are all strictly monacid.

Of the N_4 , caffeine, M. Schorlemmer says—"It is a monacid base."

Such cases might be multiplied *ad infinitum*, and, as no special selection has been made, I give the only contrary case from my rough notes; it is that of acridine, which is perfectly parallel with the case of dipyrindine. It is either $\text{C}_{12}\text{H}_9\text{N}$ or $\text{C}_{24}\text{H}_{18}\text{N}_2$; and in the latter case, all the acids in a long list are di.

That chemists should assume so much, where the simple truth of nature could be easily and finally tested, is to me a regrettable amazement.

I have long thought that, as O=8, S and Pt, like Cl, replace H, atom for atom, so there should be no reason why C=6 and Si should not also form one of the ammonia constituents. I have collated several cases in this direction, and a recent memoir on "Guanimine" is specially appropriate.



In conclusion, I would call attention to a very notable fact, viz., that guanamine as a poly-amine has 16 H equivalents, and not 20; and all the others are similarly proportionate. It is so by a law of genesis, as fertile and predominant with amines as it is with hydrocarbon hydrates; yet the contrary is assumed in all the manuals, and Dr. Armstrong is silent on the subject.

That truth is paramount now as when uttered by the stifled voice of Galileo is, however, seen in the tardy admission involved in Dr. Hofmann's elegant demonstration before the Chemical Society, that, when Cl replaces O, it does so by the absorption of one volume for the elimination of half a volume.

NOTES ON THE ANALYSIS OF MINIMUM OR RED LEAD.

By THOMAS P. BLUNT, M.A., Oxon, F.C.S.

THE analysis of red lead presents peculiar difficulties, principally due to the minute proportion of impurities to be found in good samples. The following process includes the more important of these, viz., (1) iron, (2) copper, (3) metallic lead, and to these is added a new method of estimating the silver, which might probably be applied with advantage to the analysis of galena and metallic lead with a view to cupellation. The process given for the colorimetric estimation of copper, which is very delicate and precise, is also new so far as the writer is aware.

(1). *Iron*.—100 grains of minium is dusted gradually with half an ounce of pure re-distilled hydrochloric acid contained in a beaker; torrents of chlorine are given off, and the consequent agitation of the liquid prevents caking, which invariably occurs when the acid is poured over the weighed sample, and is very troublesome, as it prevents the interior of the lumps from being properly acted upon by the acid. The beaker and its contents are now transferred to the water-bath, and evaporation is carried almost to dryness; the residue is then diluted with

some quantity of water, and the whole allowed to cool; the clear liquid is now decanted off as closely as possible from the chloride of lead which has precipitated, and the latter is washed with a small quantity of cold water, the rinsings being added to the bulk of the liquid, which need not be absolutely clear. Sulphuric acid is then added, and the precipitation, decantation, and slight washing, repeated.

The liquid, which is now almost free from lead (though still retaining traces, apparently in the form of a per-salt not entirely decomposable by sulphuric acid) is in a fit state for the determination of iron and copper. Ammonia in considerable excess is added, and the precipitate is collected on a filter and washed. It is yellowish-white in colour, and contains all the iron and some lead. After thorough washing the filter is pierced, the precipitate washed into a small flask as completely as possible, and the filter rinsed several times with dilute sulphuric acid, which is allowed to run into the flask; the whole is then warmed, upon which the oxide of iron is dissolved, and the traces of lead-salts converted into sulphate, which does not interfere with the succeeding operation, though it is reduced to the metallic state. The liquid is now heated for some time with a few fragments of perfectly pure zinc, filtered, and titrated with very weak permanganate solution, which may be conveniently delivered from a pipette divided into grains. The permanganate solution should be of such strength that at least 1000 grain-measures are required to peroxidise 1 grain of metallic iron.

(2). *Copper*.—The ammoniacal filtrate from the iron oxide is neutralised with acetic acid and divided into two equal portions; to one of them is added a small measured quantity (about 3 grains) of ordinary ferrocyanide of potassium solution; a red colour will be produced more or less deep according to the quantity of copper present; the liquid is filtered *immediately** through close paper, and if the red colour is not entirely removed it is passed a second time through the same filter. The clear and very faintly yellow solution is then transferred to one of two twin beakers, the other containing the second portion of solution from which the copper has not been removed. A measured quantity (about 20 grains) of acetic acid is now added to each, and three grain measures of ferrocyanide solution to that which has not yet received any; the beakers are placed on a white surface, and the colour produced by the copper in the second beaker is matched in the first by the gradual addition, with stirring, of a standard solution of copper sulphate from a graduated pipette, about a minute being allowed between each addition for the full development of the tint. The copper solution is made by dissolving 39.3 grains of pure crystallised copper sulphate (free from efflorescence) in 10,000 grains of distilled water, which gives 1 part of metallic copper in 1000 measured grains. The number of grain measures required multiplied by 2 and transferred to the third decimal place, gives the percentage of metallic copper; thus,—to take an actual case,— $3\frac{1}{2}$ grain measures of the solution were required to match the tint given by the copper in a minium treated as above; therefore the sample contained 0.007 per cent of copper.

It is absolutely necessary to use a comparison liquid prepared in the manner described, and corresponding exactly to the solution to be tested, except that it contains no copper, since it has been proved by careful experiment that the quantity of ammoniacal salts present has a material effect upon the tint produced.

(3). *Metallic Lead*.—This impurity is generally found in the form of minute beads distributed throughout the sample; it is best detected and estimated by dissolving the lead oxides in glacial acetic acid in the following manner:—1 oz. of acetic acid of the kind commercially

described as "glacial at 32°" is placed in a beaker, and 20 grains of the minium—which must of course be in fine powder—is dusted into it; the beaker is placed in warm water (about 100° F.) and the contents frequently stirred; in the course of from a quarter to half an hour the whole of the lead oxides present will be dissolved, metallic lead remaining behind, together with any foreign matter such as bole, which may have been added as an adulterant. The solution may be decanted off, and the residue washed first with glacial acid and then with water, dried, and weighed.

It has been found that minute fragments of bright metallic lead are not appreciably acted upon by the acetic solution of minium, in spite of its well known powerfully oxidising properties, but are merely superficially tarnished without entirely losing their lustre.

(4). *Silver*.—200 grains of minium are treated with a mixture of $\frac{1}{2}$ oz. of nitric acid, sp. gr. 1.42, entirely free from chlorine, and $1\frac{1}{2}$ ozs. distilled water also free from chlorine, and giving no turbidity with silver nitrate; the mixture becomes hot. It is stirred at intervals during two hours, and is then diluted with pure distilled water to about 4 ozs., and filtered, the residue being washed once with a small quantity of distilled water. The filtrate, which should measure from $4\frac{1}{2}$ to 5 ozs., is then divided into two equal parts. The rest of the process is similar in principle to that employed for copper, but here turbidity, not colour, forms the basis of comparison. The two halves of the liquid having been placed in two similar beakers, one is set aside and covered with a watch-glass, to the other is added one drop of strong hydrochloric acid; a precipitate will appear which re-dissolves on stirring, leaving only a faint turbidity due to the silver. Allow to stand for a short time and filter, washing once with a few drops of distilled water; return the filtrate and washings to the beaker, and place the latter beside that which has been set aside. Both beakers should be placed *in front* of a black surface of cloth or dull silk, to facilitate the estimation of the turbidity. Add now one drop of strong hydrochloric acid to the beaker from which the silver has not been removed, stir, and note the turbidity produced, which is to be matched in the other beaker by stirring in measured quantities—about one grain at a time—of a dilute solution of nitrate of silver, prepared by dissolving 15.7 grains of the crystals in 10,000 grains of pure distilled water. The solution contains 0.001 grain metallic silver in every measured grain, and consequently the number of grain measures added to produce the required turbidity give the percentage of silver at the third decimal place. An interval of about half a minute should be allowed between each addition, and both solutions should be frequently stirred during the operation. The use of the "comparison liquid" is rendered necessary by the fact that the dissolved lead salts diminish the apparent turbidity produced by the chloride of silver. The phenomenon is not easy of explanation, as it is independent of any solvent action, and takes place equally in a solution which has been saturated with silver chloride by a previous precipitation.

Researches on Magnetic Rotatory Polarisation.—M. H. Becquerel.—Since Faraday's discovery the phenomenon of magnetic rotatory polarisation has been the subject of numerous researches. It has been remarked that bodies strongly refractive have generally also a great magnetic rotatory power; but the exceptions to this rule have hitherto prevented any connection between these two physical attributes from being established. The author finds in his experiments that many bodies present a regular increase of rotation as the index of refraction augments. The exceptions observed may be attributed either to the effects of lamellar polarisation, as in the diamond and garnet; or to the presence of magnetic bodies; or, lastly, to unknown causes.—*Comptes Rendus*, vol. lxxx., No. 22.

* If the filtration is delayed a yellow colour is produced which interferes materially with the subsequent operation; it appears to be due to the oxidation of the ferro- to ferri-cyanide.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS
DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 274).

If we consider oxygen from these three points of view, its metallurgical applications first draw our attention. What it has already done for the platinum manufacture has been explained above. For the autogenous soldering of lead it has been dispensed with, since hydrogen or coal-gas burnt in atmospheric air gives out a sufficient heat; but the example of this art encourages us in connecting great hopes with the extended applications of oxygen. Says an esteemed practical metallurgist, Clemens Winkler:†—"As gold, when used for soldering platinum vessels, impairs the appearance, since the soldered places appear yellow, in the same manner the whiteness of soft solder is an eyesore when it is applied to coloured metals. This evil induced the Prussian Association for the Promotion of Manufacturing Industry to offer a reward for the discovery of a yellow solder—a problem not easy to solve without the prior discovery of a new easily fusible metal of a red or yellow colour.‡ It would be more useful to turn our attention to the autogenous soldering of metals with the aid of the oxyhydrogen flame, a principle which has achieved such signal triumphs in the treatment of two essentially different metals. Should it not be possible, by the same means, to solder every metal and every alloy with itself, as tin with tin, copper with copper, brass with brass, silver with silver, gold with gold, and even iron with iron, just as we already solder lead with lead and platinum with platinum? The probability is present, and the advantages of such a procedure are manifest. Let us try to conceive the neatness of a workshop in which soldering is performed, not as heretofore, with the soldering-iron or at the forge, but with a light, elegant gas-burner. Imagine the artisan no longer annoyed by radiant heat and by the fumes of charcoal, and able to produce in a moment any temperature required, even the very highest, and again to put an end to it by simply turning a cock. Conceive the solidity of the soldering which no longer depends on cementing two pieces of metal with a foreign matter, but on an actual interfusion of two portions of one and the same metal, and which involves the utmost economy of materials and dispenses with all subsequent work, such as trimming the soldered place with a file. Such evident advantages must overcome every prejudice, and prompt us most urgently to commence a thorough experimental investigation of the question."

But also in the most extensive fields of metallurgy, the preparation of iron and steel, technologists of merit have pointed out the advantages to be derived from cheap oxygen.

Cameron|| recommends the use of oxygen or of air rich in oxygen, as obtained from Mallet's absorption-cylinders instead of ordinary air in blast-furnaces; and we may here remark that the absorption of oxygen in water has been already unintentionally used for this purpose, although in a form capable of improvement. Br. Kerl§ has called attention to the fact that the air from the water-blast is richer in oxygen than common air.

(To be continued.)

ON THE ESTIMATION OF PHOSPHORIC ACID
AS AMMONIO-MAGNESIAN PHOSPHATE.

By THOMAS ROBERTSON OGILVIE.

(Continued from vol. xxxi., p. 275.)

C.—Precipitation of P_2O_5 in Presence of Varying Quantities of Ammonium Sulphate and an Excess of Magnesia-Mixture.

| No. of Expt. | NH_4O, SO_3 . | Mg. Mix. = 7 c.c. |
|--------------|-----------------|-------------------|
| 1 | 0.25 grm. | 0.3160 grm. |
| 2 | 0.50 " | 0.3160 " |

In the analysis of a superphosphate there cannot be more than a limited quantity of sulphuric acid present. This acid, originally in the manure as calcic sulphate and free acid—and possibly also as ammonium sulphate—remains in the portion employed for analysis after the removal of the lime as ammonium sulphate. There can never be more than 50 per cent of this salt associated with the phosphoric acid in its precipitation, as hydrochloric acid, and not sulphuric acid, is used as the solvent for the portion of the manure insoluble in water; and so it is altogether irrelevant to consider the interfering effect of a greater quantity of this salt. It is different with ammonium chloride, as it may be present in greater or less quantity according as hydrochloric acid is used sparingly or otherwise.

These experiments, along with the ones in (A b) show that the addition of much sulphuric acid, combined with magnesia, and without a relative increase in ammonium chloride, leads to high results; and that the addition of a moderate quantity of sulphuric acid, associated with ammonia, and in presence of not more than 50 per cent of an excess of "magnesia-mixture," does not do so.

D.—Precipitation of P_2O_5 in Presence of Varying Quantities of Ammonium Oxalate and of Magnesia-Mixture.

| No. | NH_4O, \bar{O} . | Mg. Mix. 7 c.c. | Mg. Mix. 13.5 c.c. | Mg. Mix. 20 c.c. |
|-----|--------------------|-----------------|--------------------|------------------|
| | grm. | grm. | grm. | grm. |
| 1 | 0.25 | 0.3130 | 0.3260 | 0.3295 |
| 2 | 0.50 | 0.3120 | 0.3295 | 0.3300 |
| 3 | 1.00 | 0.3120 | 0.3285 | 0.3270 |
| 4 | 1.50 | 0.3090 | 0.3255 | 0.3310 |
| 5 | 2.00 | 0.3075 | 0.3255 | 0.3320 |
| 6 | 2.50 | 0.3065 | 0.3255 | 0.3285 |

E.—Precipitation of P_2O_5 in Presence of Varying Quantities of Citric Acid and Magnesia-Mixture.

| No. | Citric Acid. | Mg. Mix. 7 c.c. | Mg. Mix. 13.5 c.c. | Mg. Mix. 20 c.c. |
|-----|--------------|-----------------|--------------------|------------------|
| | grm. | grm. | grm. | grm. |
| 1 | 0.25 | 0.3105 | 0.3215 | 0.3250 |
| 2 | 0.50 | 0.3100 | 0.3240 | 0.3270 |
| 3 | 1.00 | 0.3100 | 0.3240 | 0.3265 |
| 4 | 1.50 | 0.3070 | 0.3220 | 0.3230 |
| 5 | 2.00 | 0.3055 | 0.3200 | 0.3220 |
| 6 | 2.50 | 0.3040 | 0.3175 | 0.3230 |

F.—Precipitation of P_2O_5 in Presence of a Fixed Quantity of Citric Acid, Varying Quantities of Ammonium Oxalate, and Varying Quantities of Magnesia-Mixture.

| No. | Citric Acid. | NH_4O, \bar{O} . | Mg. Mix. 7 c.c. | Mg. Mix. 13.5 c.c. | Mg. Mix. 20 c.c. |
|-----|--------------|--------------------|-----------------|--------------------|------------------|
| | | grm. | grm. | grm. | grm. |
| 1 | 0.50 | 0.25 | 0.3115 | 0.3265 | 0.3310 |
| 2 | 0.50 | 0.50 | 0.3115 | 0.3275 | 0.3345 |
| 3 | 0.50 | 1.00 | 0.3105 | 0.3260 | 0.3370 |
| 4 | 0.50 | 1.50 | 0.3080 | 0.3235 | 0.3355 |
| 5 | 0.50 | 2.00 | 0.3070 | 0.3235 | 0.3340 |
| 6 | 0.50 | 2.50 | 0.3050 | 0.3230 | 0.3330 |

G.—Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Varying Quantities of Citric Acid, and Varying Quantities of Magnesia-Mixture.

| No. | Citric Acid. | NH_4O, \bar{O} . | Mg. Mix. 7 c.c. | Mg. Mix. 13.5 c.c. | Mg. Mix. 20 c.c. |
|-----|--------------|--------------------|-----------------|--------------------|------------------|
| | | grm. | grm. | grm. | grm. |
| 1 | 0.25 | 0.50 | 0.3120 | 0.3310 | 0.3355 |
| 2 | 0.50 | 0.50 | 0.3110 | 0.3270 | 0.3340 |
| 3 | 1.00 | 0.50 | 0.3070 | 0.3265 | 0.3340 |
| 4 | 1.50 | 0.50 | 0.3045 | 0.3250 | 0.3345 |
| 5 | 2.00 | 0.50 | 0.3035 | 0.3210 | 0.3285 |
| 6 | 2.50 | 0.50 | 0.3020 | 0.3160 | 0.3250 |

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Clemens Winkler, *Deutsche Industrie Blätter*, p. 182. *Zeitschrift d. Vereins Deutsch. Ingen.*, xvi., 714.

‡ The offer has, therefore, been subsequently withdrawn.

|| Cameron, *Berg. u. Hüttenm. Zeitung*, 1871, 132.§ Br. Kerl, *Grundriss der Hüttenkunde*, i., 217.

These four series of experiments (D to G) set forth very plainly the action of ammonium oxalate and citrate. Two features of this action must be noted:—First, that in presence of a moderate excess of “magnesia-mixture” both salts render the precipitate of ammonio-magnesian phosphate to a greater or less extent soluble according to the quantity of each present, and in that way cause the results to be low; and, second, that in presence of a larger excess of “magnesia-mixture” this solvent action is counter-balanced by the precipitation of magnesium oxalate and citrate, along with the ammonio-magnesian phosphate, and so high results are got. These experiments, I think, indicate why one authority asserts that ammonium citrate gives a precipitate, and another that it does not, with “magnesia-mixture.” Hitherto, little attention has been given to the action of ammonium oxalate, but these tables show that its presence is nearly as objectionable as that of ammonium citrate; and I am afraid that some analysts, under the impression that lime will not come down by boiling within a short time unless a large excess of ammonium oxalate is present, often vitiate their estimations by its excessive use. Even, however, by using the least possible quantities of these salts an erroneous result will be got, which will be either low or high according as a moderate or a large excess of magnesia is employed. It is worthy of remark, also, that in the experiments in which the largest proportion of “magnesia-mixture” was used, the precipitates were not only the highest, but the most irregular in weight and colour.

H.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.*

| No. | NH_4O, \bar{O} . gram. | Citric Acid. gram. | Fe_2O_3 . gram. | Al_2O_3 . gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$. gram. |
|-----|-----------------------------|--------------------------|----------------------|----------------------|---------------|---------------------------|
| 1 | 0.5 | 0.5 | 0.035 | 0.013 | 7 | 0.3225 |
| 2 | 0.5 | 0.5 | 0.035 | 0.013 | 13.5 | 0.3280 |
| 3 | 0.5 | 0.5 | 0.035 | 0.013 | 20 | 0.3440 |

I.—*Same as (H), but with Double the Quantity of Citric Acid.*

| No. | NH_4O, \bar{O} . gram. | Citric Acid. gram. | Fe_2O_3 . gram. | Al_2O_3 . gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$. gram. |
|-----|-----------------------------|--------------------------|----------------------|----------------------|---------------|---------------------------|
| 1 | 0.5 | 1 | 0.035 | 0.013 | 7 | 0.3195 |
| 2 | 0.5 | 1 | 0.035 | 0.013 | 13.5 | 0.3190 |
| 3 | 0.5 | 1 | 0.035 | 0.013 | 20 | 0.3200 |

K.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.*

| No. | NH_4O, \bar{O} . gram. | Citric Acid. gram. | Fe_2O_3 . gram. | Al_2O_3 . gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$. gram. |
|-----|-----------------------------|--------------------------|----------------------|----------------------|---------------|---------------------------|
| 1 | 0.5 | 1 | 0.07 | 0.026 | 7 | 0.3170 |
| 2 | 0.5 | 1 | 0.07 | 0.026 | 13.5 | 0.3280 |
| 3 | 0.5 | 1 | 0.07 | 0.026 | 20 | 0.3565 |

L.—*Same as (K), but with Double the Quantity of Citric Acid.*

| No. | NH_4O, \bar{O} . gram. | Citric Acid. grams. | Fe_2O_3 . gram. | Al_2O_3 . gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$. gram. |
|-----|-----------------------------|---------------------------|----------------------|----------------------|---------------|---------------------------|
| 1 | 0.5 | 2 | 0.07 | 0.026 | 7 | 0.3115 |
| 2 | 0.5 | 2 | 0.07 | 0.026 | 13.5 | 0.3085 |
| 3 | 0.5 | 2 | 0.07 | 0.026 | 20 | 0.3095 |

M.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Proportions of Magnesia-Mixture.*

| No. | NH_4O, \bar{O} . gram. | Citric Acid. grams. | Fe_2O_3 . gram. | Al_2O_3 . gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$. gram. |
|-----|-----------------------------|---------------------------|----------------------|----------------------|---------------|---------------------------|
| 1 | 0.5 | 4 | 0.07 | 0.26 | 7 | 0.2810 |
| 2 | 0.5 | 4 | 0.07 | 0.26 | 13.5 | 0.2700 |
| 3 | 0.5 | 4 | 0.07 | 0.26 | 20 | 0.2665 |

(To be continued).

SOCIETY OF PUBLIC ANALYSTS.

The following paper was read at the meeting on June 2nd:—

ON THE VOLUMETRIC ESTIMATION OF CHLORIDES AND THE PRESENCE OF ALKALINE PHOSPHATES.

By W. C. YOUNG, F.C.S.

IN endeavouring to estimate the chlorine volumetrically in a sample of vinegar suspected to contain free hydrochloric acid, I found it almost impossible to decide when the change of colour first took place; instead of the usual deep red precipitate, a light brown precipitate appeared, and the colour did not change until so much of the standard solution had been used as convinced me something was wrong. At first, I attributed the cause to the alkaline carbonates present, of which, as the vinegar had been neutralised by soda before evaporation and incineration, there was a considerable quantity. After carefully neutralising a fresh portion of ash by acetic acid, the same difficulty occurred in the volumetric estimation of the chlorine.

On investigation, the cause of the difficulty proved to be the alkaline phosphates present; and, after precipitation by sulphate of calcium, the total chlorine in this vinegar amounted to 1.75 grains per 1000, whereas before it amounted to 2.8 grains per 1000, this being calculated from the number of grain measures of standard solution of nitrate of silver required to produce the first perceptible alteration in the colour of the precipitate. Thus, a difference of 1.05 grains of chlorine was occasioned by the alkaline phosphates in the ash.

In order to see how much the volumetric estimation of chlorine was affected by the presence in solution of carbonate of sodium, phosphate of sodium, or pyrophosphate of sodium, I made the following experiments. 0.7 grain of chloride of sodium was taken in each case, and a few drops were added of a strong solution of one of the salts supposed to affect its estimation volumetrically. A considerable excess of chromate of potassium was used.

| | Cold. | At about 120° F. |
|--|---------|---------------------|
| Gr. Cl. | Gr. Cl. | Gr. Cl. |
| 0.7 grain NaCl with Na_2CO_3 indicated | 0.425 | 0.435 |
| „ „ „ Na_2HPO_4 „ | 0.430 | 0.465 |
| „ „ „ $Na_4P_2O_7$ „ | 0.575 | 0.750 |

By these results, it will be seen that the presence of carbonate of sodium did not affect the estimation in the cold, and only slightly when hot; phosphate of sodium in the cold only affects the estimation slightly, but rather more when hot; while pyrophosphate of sodium interferes to so great an extent, that it is obvious that volumetric estimations of chlorine in its presence are worthless.

In the first experiment the change of colour was easily observed, the depth increasing at each addition of the standard solution; whilst in the second the change of colour was so gradual that it was difficult to decide when it first occurred—moreover, the colour pervaded the whole precipitate, instead of, as is usual, the liquid above the precipitate. The third experiment presented the same appearance as the second.

I tried the effect in hot solutions as well as cold, because the standard solution is frequently applied immediately after the solution of an ash in hot water.

Having observed this effect of the alkaline phosphates, I proceeded to find how far the estimation of chlorides in ashes is affected by the phosphates contained therein.

Vinegar Ash.—The normal ash of the sample used indicated 0.14 Cl per 1000; after precipitation by sulphate of calcium, it indicated 0.13 Cl per 1000. After adding a few drops of hydrochloric acid to this vinegar and carefully neutralising by potash, the solution of the ash behaved in precisely the same manner with the standard solution of nitrate of silver as did the vinegar already referred to as

directing my attention to this subject, and it was impossible to say when the precipitation of the chloride of silver had ceased. 3.5 grains of Cl had been indicated long before a decided red tint was observable.

There is no doubt that, in this experiment, a large amount of the insoluble phosphate had been converted into alkaline phosphate by the carbonate of potash formed by the ignition of the potash salts present.

After separation of phosphates, 1000 = 0.55 Cl.

Milk Ash.—The amount of alkaline phosphate present in normal milk ash is so small that its effect upon the estimation of the chlorides is inappreciable; but with milk to which carbonate of sodium has been added, the alkaline phosphates in the ash are increased and the effect is more marked. The lowest and highest differences I have observed are these:—

| | Before Pre- cipitation of Phosphates. Gr. | After Pre- cipitation of Phosphates. Gr. |
|-------------------------------------|--|---|
| Cl in ash from 100 grain measures = | 0.082 | 0.078 |
| „ „ „ = | 0.090 | 0.084 |

Beer Ash.—

| | Before Precipitation of Phosphates. | After Precipitation of Phosphates. |
|----------------------|---|--|
| 1. Cl per 1000 | 0.320 | 0.301 |
| 2. „ „ | 0.371 | 0.360 |

When an alkaline carbonate has been added to beer to correct acidity, the alkaline phosphates in the ash are increased, and the difference before and after their separation is very decided, as will be seen from the following experiment:—

| | Before Precipitation of Phosphates. | After Precipitation of Phosphates. |
|-------------------|---|--|
| Cl per 1000 | 0.5 | 0.32 |

Cocoa Ash.—In applying the volumetric solution of nitrate of silver to the ash of cocoa, at first no precipitate is formed, then for some time a white precipitate, afterwards a light brown precipitate, and finally chromate of silver. It was almost impossible to decide when the first alteration of colour occurred. The ash from 50 grains of this cocoa indicated, after precipitation of the alkaline phosphates, 0.01 grain Cl.

In short, the appearances presented in this experiment were precisely the same as if pyrophosphate of sodium had been used instead of the ash of cocoa.

Thus, the volumetric estimation of chlorine in the ash of vinegar, beer, milk, or cocoa is affected more or less by the alkaline phosphates present.

A BATCH of milk adulteration cases recently disposed of at the Greenwich Police Court gave occasion for the display of a phase of the magisterial mind which is, perhaps, unique.

The cases were five in number. The largest quantity of added water certified to was 33 per cent, and, as the defendant in this case was fined 40s., no special remark is called for.

Of the other four milk dealers, one had added 10 per cent of water, one 15 per cent, and the remaining two each 18 per cent. The first case the magistrate at once dismissed, asserting his opinion that the discovery of such a small quantity of added water was an analytical impossibility. The solids not fat in this case were only 7.92. The other three cases were adjourned for a week, to enable the magistrate to make up his mind. At the adjourned hearing the Analyst was in attendance to verify his results, but the magistrate declined to let him be examined, and, notwithstanding that there was no defence and no counter testimony, he simply ordered the defendants to pay the cost of the summonses, some two shillings each. The amount of solids not fat in these three cases was, respectively, 7.11; 7.42, 7.32.

NOTICES OF BOOKS.

Chemical and Geological Essays. By THOMAS STERRY HUNT, LL.D. Boston: J. R. Osgood and Co. London: Trübner and Co.

IN Europe, as in America, Dr. T. S. Hunt is widely and honourably known as an acute and indefatigable investigator of nature. In chemistry, mineralogy, and geology, and especially in the bearings of the former science upon the latter, he has done work of standard merit and of abiding interest. The volume before us comprises essays on the theory of igneous rocks and volcanoes; on certain points in chemical geology, including a comparison of ancient and modern sea-waters, and considerations on the geological distribution of volcanoes; on the chemistry of the metamorphic rocks; on the chemistry of the primæval earth, in which the author accounts for the climatic heat of certain geological epochs by showing that the relatively large amount of carbonic acid in the atmosphere must, as demonstrated by Tyndall, arrest the loss of heat by nightly radiation; on the origin of mountains; on the probable seat of volcanic action; on some points in dynamical geology, in which he adopts the physical theory of earthquakes propounded by G. L. Vose; on limestones, dolomites, and gypsums; on the chemistry of natural waters, with an appendix on the porosity of rocks; on petroleum, asphalt, pyroschists, and coal, in which he combats the view that petroleum has been formed by the destructive distillation of the pyroschists (*brand schiefer*); on granites and granitic vein-stones; on the origin of metalliferous deposits, with an appendix on the presence of iodine and gold in sea-water, as established by Sonstadt (*CHEMICAL NEWS*, 1872, April 26, May 17, and May 24); on the geognosy of the Apalachians, and the origin of crystalline rocks; on the geology of the Alps; on the history of the names Cambrian and Silurian in geology; on the theory of chemical changes and on equivalent volumes; on the constitution and equivalent volume of mineral species; thoughts on solution and the chemical process, where the author contends that all solution is chemical union; on the objects and method of mineralogy, and on the theory of types in chemistry.

These essays are not, indeed, new to the scientific world. Some of them have been read before distinguished learned societies, and all have appeared in print in the *Chemical Gazette*, *American Journal of Science*, *Dublin Quarterly Journal*, *Canadian Journal*, &c., and one, at least, has been the subject of discussion in our own columns. Still their re-publication in a compact form will prove a great convenience to the student, who might otherwise be compelled to seek them, for reference, through a great bulk of periodical literature.

In examining the work we were much struck with the following passage, appended as a footnote to the paper on the "Theory of Types:"—"Those who are familiar with chemical literature will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radicle theory to a newly-invented electro-negative radicle, eurrhizene (*Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376). A late writer in the *CHEMICAL NEWS* (vol. i., p. 326) proposes as a new electro-negative radicle, under the name of hydrine, the peroxide of hydrogen, HO₂, the eurrhizene of Laurent." Were Laurent still living, he would be ostracised if he dared to "speak disrespectfully" of eurrhizene, under its new *alias* of hydroxyl!

The following passage may not be unworthy of attention:—"I am convinced that no geometrical grouping of atoms, such as are imagined by Macvicar and by Gaudin, can ever give us an insight into the way in which Nature builds up her units."

CORRESPONDENCE.

FILTERING CONES.

To the Editor of the Chemical News.

SIR,—Most chemists in the habit of using Bunsen's filtering apparatus must have experienced some inconvenience in the use of the platinum cones. At the recommendation of a friend, I was induced to try the following simple substitute for them, and found it to answer so well, that I would call the attention of your readers to it, in case it is not generally known. Place inside of the glass funnel used a small filter of parchment-paper pierced at the bottom with a fine needle; afterwards place the ordinary filter in the funnel, and filter as usual. Such cones of parchment-paper can be used in any required size, are easily obtained, and may be applied to almost all purposes where the more expensive platinum cones have hitherto been used.—I am, &c.,

M. H. COCHRANE.

Tübingen, June 20, 1875.

BLOOD ALBUMEN.

To the Editor of the Chemical News.

SIR,—Seeing in CHEMICAL NEWS, vol. xxxi., p. 269, a short note referring to E. Kopp's process for the decolorisation of blood albumen by means of *ozonised air*, I am reminded of a process of my own which is somewhat similar in its nature, and for the same purpose, but which fell through as a commercial undertaking on the score of *expense*; but, nevertheless, I doubt not will be considered interesting.

My process consists in simply dissolving the dark coloured blood albumen of commerce in water at about 100° F., and then (after separation from the insoluble portion which always exists in this quality of albumen) adding, whilst hot, a small quantity of *bin oxide of hydrogen*. The nascent oxygen, or ozone, which is thus liberated acts *immediately* upon the colouring matter of the serum, and, upon evaporation of the latter to dryness upon a flat glass plate or bath, the albumen readily peels off, and is obtained of a light straw colour and completely soluble in water.—I am, &c.,

GEORGE JONES, F.C.S.

106, Leadenhall Street, E.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 22, June 7, 1875.

Transformation of Camphor into Camphene and, Reciprocally, of Camphenes into Camphor.—M. J. Ribau.—The conversion of camphor into camphene gives considerable support to the opinion which regards the camphenes as the generators of camphor.

Thiammeline, a New Derivative of Persulpho-Cyanogen.—M. J. Poncmareff.—The new compound, $C_3N_5H_5S$, represents ammeline, in which oxygen is replaced by sulphur. It is produced at the expense of persulpho-cyanogen by the replacement of two atoms of sulphur by two residues, NH_2 . Thiammeline dissolves readily in mineral acids and in alkalies, but it does not yield definite salts, either with acids, or with alkaline and alkaline-earthly bases. With the salts of the heavy metals it yields amorphous insoluble precipitates.

Dissociation of Sulpho-Carbonate of Potassium in Presence of Ammoniacal Salts.—M. Rommier.—Under the influence of ammoniacal salts sulpho-carbonate of potassium loses a part of the sulphide of carbon which enters into its composition.

Fluoren, and its Derivative Alcohol.—M. P. Barbier.—The author describes fluorenic alcohol, $C_{26}H_8(H_2O_2)$, obtained by causing sodium amalgam to react upon diphenyl carbonyl in alcoholic solution; fluorenic ether, $C_{26}H_8(C_2H_5O_2)$; and fluorenacetic ether, $C_{26}H_8(C_4H_4O_4)$.

Researches on Taurin.—M. R. Engel.—Taurin is not in reality an amide, but a true glycocoll, that is to say, an acid amine.

Bibromide of Angelic Acid.—M. E. Demarçay.—The author considers this body completely identical with methylcrotonic acid.

Analysis of the Coal of the Island of Suderoe.—MM. Beghin and C. Mène.—Suderoe, one of the Faroe group, contains important beds of coal in dolerite rocks. It yields—

| | |
|-------------------------|--------|
| Volatile matter | 46.520 |
| Coke | 51.980 |
| Ash | 1.500 |

100.000

Its specific gravity is 1.3531. On elementary analysis it gave—

| | |
|-------------------------|--------|
| Carbon | 70.672 |
| Hygroscopic moisture .. | 1.052 |
| Ashes | 1.500 |
| Hydrogen | 5.148 |
| Nitrogen and oxygen .. | 21.628 |

100.000

It belongs apparently to the coals of the tertiary age.

Bulletin de la Societe Chimique de Paris,
No. 10, May 20, 1875.

Characteristics of Glycocoll.—M. R. Engel.—Already noticed.

Presence of Anhydrous Sulphuric Acid among the Gaseous Products of the Combustion of Iron Pyrites.—M. Scheurer-Kestner.—Already noticed.

Phenyl - Sulphacetic and Ethyl - Sulphacetic Acids.—M. J. P. Claesson.—A most elaborate account of these acids, and of their principal salts.

Salts of Trimeta-Phosphoric Acid.—M. C. G. Lindbom.—The author describes the salts of soda, potash, ammonia, silver, baryta, lead, magnesia, iron (ferrous), manganese, the free acid, the double salts of baryta and soda, baryta and ammonia, baryta and potash, strontia and soda, lime and soda, magnesia and soda, nickel and soda, cobalt and soda. The author has not been able to obtain definite salts with the weaker bases.

Correspondence from St. Petersburg.—M. W. Louguine.—M. W. Roudneff announces that on the reduction of trichloro-lactic ether there is formed as principal product, not chloracrylic ether, but dichloro-lactic ether, and probably small quantities of mono-chloro-lactic ether. M. Socoloff communicates the result of his studies on the detection of hydrocyanic acid in cases of poisoning. The acid appears to be found in the organism in the state of double salts which do not readily react with mineral acids. M. A. Wyschnegradsky has examined the condensation of isoamylene as obtained by Ermolaëff. The diamylene produced is identical with ordinary diamylene. M. G. Kasantzeff has caused hydriodic acid to act upon acetone, and upon the phoron derived from acetone. With the latter it forms $C_9H_{12}I_2O$. M. N. Menschoutkine, by acting with dilute sulphuric, nitric, and hydrochloric acids upon the product of the combination of succinimide with cyanic ether, obtains ethyl-succinuric acid. M. Th. Beilstein, by letting the pentachloride of antimony react

upon ortho-chloro-benzoic acid, forms ortho-dichloro-benzoic acid, which melts at 150° , and distils at 300° . The third part of the seventh volume of the *Journal of the Russian Chemical Society* contains the following papers:—On the combination of cyanogen with the elements of water, by M. N. Beketoff; on the isomerism of the amylenes of the amylic alcohol of fermentation, by M. Flavitzky; on certain derivatives of desoxybenzoin, by M. A. Zagoumenny; on the application of sulphurous acid to the manufacture of alcohol from grain, by M. Mikoulinisky; and on the oxyiso-pyrovinic and bromo-cyano-butyric acids obtained by the aid of dibromo-butyric ether, by MM. Petrieff and Eguis.

Atomic Weight of Copper.—M. W. Hampe.—Assuming $H=1$, and $O=15.96$, the author makes the atomic weight of copper $=63.013$, which differs very little from 62.994 , the figure found by Berzelius (*Zeitschrift für Berg. Hutten-wesen*).

Combination of the Peroxide of Nitrogen with the Phosphate of Magnesium.—M. E. Luck.—The new compound has the composition $P_2O_6Mg_2H_2+NO_2$. It is almost insoluble in water, which it renders slightly acid. It dissolves in acids, with the escape of red vapours.

Selenite of Magnesia.—M. Hilger.—The precipitate given by selenious acid with "magnesia mixture" always contains ammonia, but in small and variable proportions (*Zeitschrift für Analytische Chemie*, xiii., p. 394.)

Dissociation of Ammoniacal Salts in Aqueous Solutions.—M. H. C. Dibbits.—Not adapted for abstraction.

The Solubility and the Dissociation of the Bicarbonates of Potash, Soda, and Ammonia.—M. H. C. Dibbits.—The tension of dissociation of bicarbonate of potash in a saturated solution is 461 m.m. at 15° ; bicarbonate of soda, 120 m.m. at 15° ; 212 m.m. at 30° ; 356 m.m. at 40° ; and 563 m.m. at 50° ; and for bicarbonate of ammonia, 720 m.m. at 15° .

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 18, June, 1875.

Report Made by M. Troost, in the Name of the Committee of the Chemical Arts, on a "Siphoid Can" for Petroleum Oils, Presented by M. Moride, of Nantes.—An account of a metallic receptacle for containing petroleum and the inflammable essences, and for permitting their transport with less danger than the cans at present in use.

Report Made by M. Salvétat on the Pallet of the Painter on Porcelain for a Medium Fire, Presented by M. Francois Richard.—M. Richard, an artist on porcelain, has studied the scale of colours suitable for wares baked in a medium fire, and holding an intermediate position between hard and tender porcelains.

Limits of the Carburation of Iron.—M. Boussingault.—Taken from the *Comptes Rendus*.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publiés, des Sciences et des Arts Appliqués à l'Industrie, March and April 1875.

This issue contains no chemical matter which has not been already noticed.

Reimann's Farber Zeitung, No. 17, 1875.

This issue contains a notice, with diagram, of an apparatus for extracting dye-woods; receipts for preventing Nicholson blues from smearing; for dyeing silk-waste a black, a white, and a yellow; for a green upon garments, both wool and mixed; and for a magenta and a light green for satins mixed with cotton.

No. 18, 1875.

This issue contains a caution against spurious qualities of commercial tannin, so-called, but containing mere

traces of true tannin, and in its stead little but gallic acid and dextrin. Such preparations, however cheap, are utterly worthless, and occasion merely annoyance to the consumer.

It is rumoured that the Russian Government has totally prohibited the importation of aniline colours, with the exception of magenta in crystals. There are, further, receipts for a Havana brown and a bronze upon wool; two processes for amaranth upon woollen cloth; a fast chrome green upon woollen yarn; a "Sedan" red, a bluish claret, and a bright brown on woollen garments; a green for printing on woollens; and a red-brown on a black ground on calico or muslin.

No. 19, 1875.

Boiler Incrustations.—Protzen recommends the introduction of a piece of zinc into the boiler. This determines a galvanic current which protects the iron against oxidation and corrosion, and causes the mineral ingredients of the water to be deposited as a fine loose mud, entirely preventing the formation of "crock."

The Hydrosulphite Vat.—The bisulphite of soda is used in solution at 5° B. 100 litres are poured into the air-tight agitation-cask, with 7 kilos. of zinc-powder, and stirred for twenty minutes. The liquid, which is now converted into hydrosulphite, is drawn off into a pair of large closed tubs containing milk of lime, formed of 1 part of lime to 5 of water. The liquids are well mixed in these tubs, and allowed to settle till the supernatant solution of hydrosulphite is quite clear, and slightly alkaline. Of this liquid 40 litres are taken to 1 kilo. of ground indigo. This weight of the colour—ground wet—is placed in a tub holding about 50 litres, the 40 litres of hydrosulphite are added, and the whole heated to 60° . 1 to 2 litres of milk of lime are then added, and, if needful, a few more litres of the hydrosulphite, until the mixture is a fine yellow. Lime plays an important part in the reduction of the indigo, and must be used with caution. The reduced indigo is then poured into the vat which contains merely water, but which, after the introduction of the indigo, must have a slightly alkaline reaction. From time to time, therefore, the addition of milk of lime is necessary. When it is required the vat loses its greenish yellow colour, and turns black. If too much lime is added the wool feels harsh when taken from the vat, and the indigo is not fixed, being capable of removal by washing with soap. In such cases acid must be added to the vat.

There are also in this issue receipts for a green, a Nicholson blue, and a crimson on waste silk; for an aniline blue on woollen piece goods; for a white, blue, green, and yellow design on a Turkey red ground; and a black on felt hats.

No. 20, 1875.

This issue contains receipts for a fast pansy on fine woollen cloth; for a dark blue on the same material; a saffranin ponceau, scarlet, and rose, and a fast aniline blue on cotton; a grey, silver-grey, and brown on cotton with the new colours of Croissant and Bretonnière; a light green, brown, and cherry-brown on jute; a dye for the "birls" in light green cloth; for printing a black, red, rose, green, yellow, and blue design, and a Prussian blue on linen.

No. 21, 1875.

The price of artificial alizarin has fallen about 35 per cent. Hargreaves's improvements in the alkali manufacture are making rapid progress, whilst the ammonia process is not found to work well.

Chloride of barium, as a remedy for boiler incrustations, gives general dissatisfaction.

Another reduction in the value of borax has taken place, owing to the influence of the Californian deposits.

Albumen for printing purposes is becoming scarce, and a new source is greatly needed.

Hofmann's process for preparing aniline violets by means of iodide of ethyl is now generally abandoned in favour of

Poirrier and Chappat's patent (nitrite of methyl. The blue shades are obtained by digestion with nitro-benzid in an autoclave; the red ones in a similar manner with magenta-violet.

There are also in this issue receipts for a fast aniline violet on wool; for dyeing artificial hair; for a yellow and a green on linen yarns and pieces.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in furnaces or apparatus for the manufacture of alkalies and other purposes. Christopher James Schofield, manufacturing chemist, Clayton, near Manchester, Lancaster. September 3, 1874.—No. 3025. This invention relates to furnaces with annular revolving beds and fixed roofs, as described in the Specification of patent No. 46, of 1871, and relates to constructing them with openings or spaces between the tops of the outer annular walls of the beds and the fixed roofs through which the treated materials may be removed from the beds, and the use in conjunction with such openings of inclined plates or deflectors for deflecting the materials as the beds rotate, so that the materials shall pass out over the outer sides of the beds. In some cases pillars and rings may be substituted for walls to carry the outer peripheries or edges of the roofs.

Improvements in the means and processes employed for treating and preserving animal substances for use as food. Henry Bolleter, Foley Street, Middlesex. September 5, 1874.—No. 3055. This invention has for its object improvements in the means and processes employed for preserving animal substances for use as food. For this purpose the gelatine in the meat to be preserved is solidified by means of a compound consisting of two-thirds common salt and one-third nitre, which is spread over the surface of the meat or animal matter in the proportion of about half an ounce or thereabouts to each pound of solid meat. The meat or animal matter thus treated is arranged in layers upon perforated plates or wire gauze, and placed in vessels arranged in an oven or chamber, to which heat is applied by steam or otherwise, in order to subject the animal substances thus treated for about ten or fifteen minutes to a temperature of 212° F. or thereabouts, according to the nature or quality of the meat so treated. The meat thus treated is further preserved by inclosing it in vessels hermetically sealed as is well understood.

Improvements in the mode of and apparatus for the extraction and treatment of sulphur. John Potter Wilkes, Trinity Square, Great Tower Street, London, and Anthony Aunier, Ladbroke Grove Road, Notting Hill, Middlesex. September 9, 1874.—No. 3087. The said invention relates to the extraction and treatment of sulphur, and consists chiefly:—First.—In passing steam or other vapours or gases containing oxygen and hydrogen, or either of them, through a retort or receptacle which contains the ores or other substances to be treated, the said substances being heated by the steam, vapours, or gases introduced, or by the application of heat directly to the retort. Second.—In the combustion or heating of the sulphuretted hydrogen generated by said process in combination with air or vapours, gases, or substances yielding oxygen to produce sulphurous acid. Third.—The employment of the sulphurous acid thus or otherwise produced, or vapours, gases, or substances yielding oxygen in a closed chamber or vessel containing sulphuretted hydrogen, by which means the sulphurous acid or the sulphuretted hydrogen or both, are decomposed, and the sulphur precipitated. Fourth.—In the treatment as above stated of sulphurous acid or sulphur fumes however generated. Fifth.—In the treatment of sulphuretted hydrogen with nitrous compounds of oxygen by passing the same into a chamber containing a vessel or vessels or trays on which the nitrous compounds are placed for the purpose of decomposing the sulphuretted hydrogen and depositing the sulphur. Sixth.—In the novel construction and arrangement of the apparatus employed in the carrying out the said process.

Improvements in the treatment of human excrement, both solid and liquid, and also other animal urine, and in the apparatus employed therein. Bridge Baron Standen, Shipley, near Bradford, York. September 11, 1874.—No. 3122. The invention relates to improvements on means described in the Specification of Letters Patent, No. 2687, 72, by which the mixing of the matters before subjecting them to the action of the acid is more thoroughly effected. The heating chamber employed for effecting the evaporation of the watery particles are heated by steam in jackets at the lower part of them, and such matter is taken from one heating vessel after it has been acted upon for a time therein, and allowed to flow into a cooler, from which it is transferred to another or other heating vessels, until it is of a pasty consistency, when it is placed in trays and in ovens to be dried. When dried it is broken up and ground for stowage and use. The vapour from the respective heating chambers is conducted away by pipes with valves and condensed by mixture with water.

NOTES AND QUERIES.

Magnesian Chloride Cement.—Can any correspondent inform me where I can get any information about cement made by adding to magnesia a solution of chloride of magnesium or chloride of calcium, and where the coarse magnesia can be obtained?—SILEX.

Hydrosulphite of Soda.—Can your readers give me any information as to how Schützenberger and Lelan's hydrosulphite of soda is made (the substance that is used in the new process of dyeing indigo-blue), as I cannot succeed with the plan of their patent?—E. R.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 815.

ANALYSIS OF CHALYBEATE WATER FROM A SPRING AT SELLAFIELD, NEAR WHITEHAVEN.

By WILLIAM H. WATSON.

THE village of Sellafield is distant about 10 miles south of the town of Whitehaven, and about $\frac{1}{2}$ a mile from the sea. The water, which rapidly forms a deposit of ferric oxide on exposure to the air, issues forth from a pipe,—a gallon in about $4\frac{1}{2}$ minutes,—the quantity, however, being much influenced by the wetness or dryness of the weather. The spring is in a field belonging to Mr. Atkinson, and at the bottom of the railway embankment of the Cleator and Egremont Company. A sample of the water, collected at 2.30 P.M., on the 2nd of June, 1875, gave on analysis the following results:—

| | Grs. per Gall, |
|--------------------------------|----------------|
| Total solid constituents | 42.570 |
| Ferrous carbonate | 9.630 |
| Manganous carbonate | 1.718 |
| Calcium carbonate | 14.500 |
| Calcium sulphate | 0.583 |
| Sodium chloride | 11.975 |
| Sodium sulphate | 2.808 |
| Magnesium carbonate | 0.710 |
| Silica | 0.410 |
| Loss and undetermined | 42.324 |
| | 0.246 |
| Total | 42.570 |

Temperature of the water as it issued from the pipe, 59° F.

Temperature of the air, 70° F.

Another sample of the water, collected on the 21st of June, gave total solid constituents 44.66 grains per gallon; difference between the samples—due very probably to the weather—2.09 grains.

Chemical Laboratory, Braystones, near Whitehaven,
July 5, 1875.

ESTIMATION OF TANNIC ACID.

By S. J. SIMPKIN.

IN decoctions of sumach, divi-divi, and similar substances tannin may be separated by precipitation with a solution of ammoniacal sulphate of copper: it is necessary that there shall be an excess of ammonia.

Extract 5 grms. of the tannin material with water and make up to 1 litre, take 10 c.c. of this decoction, acidify with sulphuric acid, add some water, and titrate with permanganate of potash. From 100 c.c. of the tannin extract precipitate the tannic acid with ammoniacal sulphate of copper, taking care that there is an excess of ammonia, and filter; the first few drops of filtrate are rejected, 10 c.c. of the filtrate acidified with sulphuric acid, watered, and titrated with permanganate.

The number of c.c. of permanganate destroyed by the solution from which the tannin has been separated, subtracted from that before removal of tannin, gives the quantity of permanganate which has oxidised tannic acid.

Bowling Dye Works, Bradford, Yorks.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 5).

It has also been observed that old charcoal burns more energetically than recent, because the former has absorbed oxygen from the air, a circumstance which has been practically utilised with advantage in refining crude iron.†

Kuppelweiser recommends air rich in oxygen for treating white crude by the Bessemer process, and he is of opinion that the cost of Tessié du Motay's process would not require to be far reduced to render oxygen available for this purpose.‡ A great future appears open here for the utilisation of oxygen. Nevertheless, Le Blanc's objection cannot be overlooked, that more infusible crucibles, furnaces, &c., would be required, the cost of which would render the advantage of the process doubtful.

Turning from metallurgy to the production of light, we must admit that, since 1826, when Drummond|| invented his oxyhydrogen light, and applied it for land-measuring and for lighthouses, no one can have questioned the value of oxygen for this purpose. As the price of the gas was reduced its application was extended, an example being especially set in America. H. Vogel,§ in the year 1870, found oxygen in successful use at New York, not merely for lighthouses, signals, and the building of houses, but also for aquatic structures and for several applications of the magic lantern. The aquatic operation in connection with the great Brooklyn Bridge over the East River, then in course of erection, were lit up with twelve oxyhydrogen lamps, which consumed daily 2000 cubic feet of oxygen.¶ Instead of lime points, the more permanent zircon cones were used with great advantage. In Paris, also, the Théâtre de la Gaité and the Alcazar were illuminated with a fairy splendour.

At the Opera House at New York,** a diagram of about 10 square metres upon a screen of damp muslin was lit up by the aid of a system of powerful lenses, whilst the lamp stood at the back-ground of the stage at the distance of 25 metres, and gave a striking effect. In conjunction with this light, the magic lantern was adopted in America to exhibit apparatus, photographs on glass, and other drawings in large lecture-halls, especially since Outerbridge discovered the way of using thin plates of gelatine for the production of lithographs or pen-drawings. The effect is easily conceived if we remember that the oxyhydrogen flame is 16½ times more brilliant than that of an ordinary burner fed with the same amount of gas.

The daily production of the New York Oxygen Company amounted in 1870 to 30,000 cubic feet, or 850 cubic metres. The gas is delivered in iron cylinders (Robert Grant's patent, New York), 9 inches in diameter and 30 inches long, which are filled with oxygen under a pressure of 20 to 30 atmospheres. The cylinder is sold at 1 dollar per cubic foot, including the oxygen contained in it at ordinary atmospheric pressure. The oxygen, on re-filling, is supplied at five cents per cubic foot under the pressure of 1 atmosphere,†† an exceedingly high price, more than twenty-two times as great as Kuppelwieser's calculation, as quoted above, although Tessié du Motay's method is in use in New York.

(To be continued.)

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† *Journ. Prakt. Chemie*, ci., 397. *Bergwerksfreund*, iii., 513.

‡ Kuppelwieser, *Berg. u. Hüttenm. Zeitung*, 1873, 354.

|| Drummond, "On the Means of Facilitating the Observation of Distant Stations in Geodetical Operations."—*Phil. Trans.*, 1826.

§ Vogel, *Ber. Chem. Gesell.*, iii., 901.

¶ Vogel says, by mistake, cubic metres.

** Morton, *Journal of the Franklin Institute*, liii., liv., lv.

†† *Deutsche Gewerbe Zeitung*, 1867, p. 18.

ON THE ESTIMATION OF PHOSPHORIC ACID
AS AMMONIO-MAGNESIAN PHOSPHATE.

By THOMAS ROBERTSON OGILVIE.

(Concluded from p. 6.)

N.—Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Ammonium Sulphate, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.

| No. | NH_4O, \bar{O} gram. | Citric Acid. gram. | NH_4O, SO_3 gram. | Fe_2O_3 gram. | Al_2O_3 gram. | Mg. Mix. c.c. | $2MgO, P_2O_5$ gram. |
|-----|---------------------------|--------------------------|------------------------|--------------------|--------------------|------------------|-------------------------|
| 1 | 1 | 0.5 | 0.25 | 0.035 | 0.013 | 7 | 0.3115 |
| 2 | 1 | 0.5 | 0.25 | 0.035 | 0.013 | 13.5 | 0.3245 |
| 3 | 1 | 0.5 | 0.25 | 0.035 | 0.013 | 20 | 0.3285 |

In (D-G) the influence of the presence of varying quantities of ammonium oxalate and citrate, without the addition of the metallic oxides, is shown; while in the experiments (H-N) the effects are brought out of the combined presence of all the ingredients usually associated with phosphoric acid in the estimation of a superphosphate, or a mineral phosphate, containing oxide of iron and alumina.

Ammonium oxalate, in proportion to the quantity present, and when not more than 50 per cent of an excess of magnesia-mixture is used, causes the results to be low. This is of importance in the analysis of bone-ash, spent charcoal, apatite, and other phosphates containing much lime and very little oxide of iron and alumina. A certain excess of oxalate will remain after the precipitation of the lime, and with the presence of only 0.5 gram., and an excess of 50 per cent magnesia-mixture, a result (D-2) of 98.73 instead of 100 was obtained. This may be taken as the amount of error in the analysis of a phosphate of lime containing little iron, with even the best working of this process. If, however, with the same quantity of ammonium oxalate, a greater excess than 50 per cent magnesia-mixture be used, a high result will be got. Thus in (D-2) with 13.5 c.c. magnesia-mixture, 104.27 was found instead of 100.

Ammonium citrate has the same action as the oxalate. With the addition of 0.5 gram. citric acid and 7 c.c., or an excess of 50 per cent of magnesia-mixture, a result (E-2) of 98.10 was obtained; while with the same quantity of citric acid and 13.5 c.c. of mixture (as the same table shows) 102.53 was found instead of 100. Under certain conditions, therefore, the solvent action of these salts is very apparent, while under other circumstances that action is hidden by the oxalate or citrate of magnesia which comes down with the phosphate precipitate; and so one chemist by using this process in one way might be known as a "low" analyst, while another by working the same process in another fashion might be sought after as a "high" analyst.

But it is of special importance to consider the effect of citric acid as shown in the experiments in which the metallic oxides were also present. The precipitates got with 0.5 gram. citric acid in (H) were slightly yellow with oxide of iron; they were each too high and increased in weight according as the excess of "magnesia-mixture" was increased. The precipitates in (I) got in the presence of the same salts as in (H), with difference of the addition of 1 gram. of citric acid instead of 0.5 gram., were granular and free from iron. They also were slightly high, but considerably nearer the truth than the results obtained in (H).

In the case, then, of the determination of phosphoric acid in a superphosphate or a coprolite containing not more than 4.8 per cent of oxide of iron and alumina, the experiment in (J-1), equivalent to 101.10, may be accepted as indicating the least error which will occur by the use of this process. Under certain conditions, it is true, a closer result might be got, as in (K-1), viz., 100.31, but as this precipitate was yellow with oxide of iron it really came close to theory by different errors equalising each other, and it therefore cannot be accepted as satisfactory.

On the other hand, by the indiscriminate use of reagents, an enormously high result may be got, as the precipitates obtained in (H-3) and (K-3), viz., 108.86 and 112.82 plainly illustrate.

O.—Precipitation of P_2O_5 in a Boiling Solution in Presence of Varying Proportions of Magnesia-Mixture.

| No. | Mg. Mix. c.c. | (Boiling.) $2MgO, P_2O_5$ gram. | (Cold.) $2MgO, P_2O_5$ gram. |
|-----|------------------|---------------------------------------|------------------------------------|
| 1 | 7 | 0.3160 | 0.3160 |
| 2 | 13.5 | 0.3230 | 0.3190 |
| 3 | 20 | 0.3245 | 0.3220 |

P.—Precipitation of P_2O_5 in a Boiling Solution in Presence of Varying Quantities of Ammonium Oxalate, and Varying Quantities of Magnesia-Mixture.

| No. | NH_4O, \bar{O} gram. | Mg. Mix. c.c. | (Boiling.) $2MgO, P_2O_5$ gram. | (Cold.) $2MgO, P_2O_5$ gram. |
|-----|---------------------------|------------------|---------------------------------------|------------------------------------|
| 1 | 0.25 | 7 | 0.3275 | 0.3130 |
| 2 | 0.50 | 13.5 | 0.3235 | 0.3295 |
| 3 | 1.00 | 20 | 0.3545 | 0.3270 |

Q.—Precipitation of P_2O_5 in a Boiling Solution in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Ammonium Sulphate, Oxide of Iron, Alumina, with Varying Quantities of Magnesia-Mixture.

| No. | NH_4O, \bar{O} gram. | Citric Acid. gram. | NH_4O, SO_3 gram. | Fe_2O_3 gram. | Al_2O_3 gram. | Mg. Mix. c.c. | (Boiling.) $2MgO, P_2O_5$ gram. | (Cold.) $2MgO, P_2O_5$ gram. |
|-----|---------------------------|--------------------------|------------------------|--------------------|--------------------|------------------|---------------------------------------|------------------------------------|
| 1 | 0.5 | 0.5 | 0.25 | 0.035 | 0.013 | 7 | 0.3320 | 0.3225 |
| 2 | 0.5 | 0.5 | 0.25 | 0.035 | 0.013 | 13.5 | 0.3065 | 0.3280 |
| 3 | 0.5 | 0.5 | 0.25 | 0.035 | 0.013 | 20 | 0.3120 | 0.3440 |

The experiments (O-Q) show the results got by precipitating the ammonio-magnesian phosphate in boiling solution in presence of various reagents. In (O-1), in which an excess of only 50 per cent of magnesia was used, the result was as correct in the boiling solution as in the cold one; but in all the other experiments the results were more or less erroneous, and in most cases even more so than in the corresponding tests done at the ordinary temperature.

R.—Influence of Re-Dissolving Precipitates got in Presence of Magnesia-Mixture only.

| No. | Mg. Mixture. c.c. | With Reprecipn. $2MgO, P_2O_5$ gram. | Without Reprecipn. $2MgO, P_2O_5$ gram. |
|-----|----------------------|--|---|
| 1 | 5 | 0.3110 | 0.3160 |
| 2 | 7 | 0.3125 | 0.3160 |
| 3 | 13.5 | 0.3150 | 0.3190 |
| 4 | 20 | 0.3160 | 0.3220 |

S.—Influence of Re-Dissolving Precipitates got in Presence of Fixed Quantities of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.

| No. | NH_4O, \bar{O} gram. | Citric Acid. gram. | Fe_2O_3 gram. | Al_2O_3 gram. | Mg. Mix. c.c. | With Reprecipn. $2MgO, P_2O_5$ gram. | Without Reprecipn. $2MgO, P_2O_5$ gram. |
|-----|---------------------------|--------------------------|--------------------|--------------------|------------------|---|--|
| 1 | 0.5 | 0.5 | 0.035 | 0.013 | 7 | 0.3085 | 0.3225 |
| 2 | 0.5 | 0.5 | 0.035 | 0.013 | 13.5 | 0.3075 | 0.3280 |
| 3 | 0.5 | 0.5 | 0.035 | 0.013 | 20 | 0.3010 | 0.3440 |

The precipitates got in (R) were allowed to stand for six hours, then the clear solution filtered off, the precipitates dissolved in the least possible quantity of hydrochloric acid, thrown down again with ammonia, and set aside for one hour. Those got in (P) were treated in the same way, with the difference that 0.5 gram. of citric acid was added to each as they contained a little oxide of iron. It will be observed that the pure precipitates got in (R-1) and (R-2) were slightly dissolved by re-precipitation; and although (R-3) is very near the theoretical quantity, and (R-4) exactly correct, it is apparent that the same solvent

action took place with them as with the others, but that it is covered over by the excess of magnesia not being dissolved. In all of the experiments in (S) the precipitates were below the theoretical quantities. The interesting observation made by Parnell (CHEMICAL NEWS, vol. xxiii., 145) that the solvent action of ammonium chloride only comes into play when there is no excess of magnesia, doubtless explains why re-precipitation so noticeably lessens even the pure precipitates of ammonio-magnesian phosphates.

The conclusions to be drawn from the whole series of experiments may be summarised thus:—

1. The estimation of phosphoric acid combined with the alkalies, as ammonia-magnesian phosphate, is perfectly trustworthy and accurate when a moderate excess of "magnesia-mixture" is used.

2. The estimation of phosphoric acid combined fully with lime only, as ammonia-magnesian phosphate, is not satisfactory under any conditions. It will yield a "low" result when a moderate excess of "magnesia-mixture" is used, owing to the solvent action of the ammonium oxalate introduced in the act of removing the alkaline earth, or a "high" result when a greater quantity of "magnesia-mixture" is used.

3. The estimation of phosphoric acid combined with lime and oxide of iron and alumina, as ammonia-magnesian phosphate, is also unsatisfactory, owing to the combined action of ammonium oxalate and ammonium citrate. High or low results may be got, according to the quantities of these salts and of "magnesia-mixture" present.

4. That precipitation in boiling solution, or re-precipitation, will not fully remedy the errors incident to the use of the reagents mentioned.

5. That by the judicious use of the reagents the least error that may be anticipated in the determination of lime phosphates by this process is 1.27 per cent, and in the determination of phosphates containing oxide of iron and alumina 1.01 per cent, while by the indiscriminate use of reagents errors up to 10 per cent or 12 per cent may be introduced.

As to the special result of this investigation, I feel warranted in condemning the use of this process in the analyses of phosphates containing iron and alumina, unless in cases in which the results are expected to be merely *closely approximate*. In all analyses that are to be the basis of money valuation, or of scientific statements, the molybdate or other method should certainly precede precipitation with magnesia.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Thursday, June 26, 1875.

Professor G. C. FOSTER, F.R.S., Vice-President, in the Chair.

THE Earl of Rosse, Mr. L. Schwendler, and Mr. R. S. Brough were elected members of the Society.

Mr. W. J. WILSON read a paper on "*A Method of Measuring Electrical Resistance of Liquids*." Great difficulty has hitherto been experienced in measuring the resistance of electrolytes on account of the polarisation of the electrodes, and most of the methods hitherto employed have aimed at reducing this to a minimum by using large electrodes and very weak or rapidly alternating currents. The determinations, however, are difficult and require to be quickly performed. The following method is easy and is free from both the above objections. The arrangement in its most simple form consists of a long narrow trough filled with the liquid to be measured, say

dilute acid. A porous pot containing a zinc plate in sulphate of zinc being placed in the acid at one end of the trough, and a similar pot with a copper plate in sulphate of copper in the acid at the other end; the whole arrangement forms a sort of elongated Daniell's cell, the chief resistance of which is in the long column of acid. The circuit between the plates being completed through a resistance-box and mirror galvanometer, the current is shunted until a suitable deflection is obtained. One of the porous pots is now moved along the trough towards the other, and, as the resistance of the circuit is thus reduced by shortening the column of acid, the galvanometer deflection largely increases. The external resistance is now increased by means of the box until the deflection is reduced to the same point as at first. This resistance put into the circuit is evidently equal to that of the liquid taken out, and thus a measure of the liquid resistance is obtained. Two forms of apparatus were shown. In one, the vessels, containing sulphate of zinc and sulphate of copper respectively, formed pistons in a glass tube which contained the liquid to be examined. In the other, two pairs of concentric vessels were connected by a bent glass tube which contained the liquid under examination. The method is applicable to a great variety of liquids, and with care almost any degree of accuracy may be obtained. The chief obstacle to exact measurements lies in the fact that the resistance of liquids is greatly affected by temperature, but this difficulty is, of course, common to all methods. Mr. Wilson has been experimenting with brine and gave some of the results obtained, but he has not as yet made a sufficient number of experiments to complete a table. A mode of arranging the apparatus in a differential or bridge form was also described, but it has not been found necessary to use it; the simple circuit arrangement giving accurate results with less trouble.

Prof. FOSTER asked whether experiments had been made in order to compare this method with Wheatstone's, which differed from Mr. Wilson's as *liquid* electrodes were not used. He then described an arrangement he had adopted for measuring the polarisation of plates in a voltameter.

Prof. McLEOD stated that he had used plates of amalgamated zinc and reversed currents to overcome polarisation. He found that some salts, chloride of zinc for instance, had points of maximum conductivity which corresponded to a definite degree of concentration.

Prof. GUTHRIE considered the research to be interesting as showing that points of minimum resistance might coincide with points of definite hydration of the salts.

Mr. WILSON, replying to Prof. Foster, stated that the chief objection to the use of metal plates is not a variation of the electromotive force of polarisation, but is due to the accumulation of bubbles of gas on the metallic surfaces.

Dr. STONE made a communication "*On Subjective Sensations of Taste*." He drew attention to two simple experiments. The first consisted in applying a strong dilution of nitric acid to the root of the tongue by sucking it through a fine glass tube. If simple water were swallowed directly after this, a powerful sweet taste was felt. The same occurred if the acid were simply sipped; though not so quickly, from the time required to remove the acid from among the papillæ. He compared this effect to the complementary images seen in the eye after gazing at a powerfully illuminated body.

He then adverted to the taste of the galvanic current. In the well-known experiment with pieces of zinc and silver, it seemed zinc was actually dissolved in the saliva. But, if the pole of a strong battery (ten Grove's cells in this case) were applied to the nape of the neck, and the other to the forehead, besides the well-known flash of light, a powerful taste was experienced of a metallic character. It disappears on breaking contact; and for this reason, as well as from the fact that the tongue is not in the direct line of circuit, and also that there is no substance in the saliva likely, by decomposition, to cause metallic depo-

sition, it could hardly be referred to chemical action, but must result from direct stimulation of the sensory apparatus. He thought a glimpse might thus be obtained of some correlation between the *modus operandi* of hearing and sight and that of taste. In the first case, a supplementary and automatic sensation, in the second the effect of a metallic solution, both entirely subjective, were excited, without the presence of any vapid substance. It seemed possible that both were due to molecular motion, as, indeed, had long ago been held with regard to smell; and that, perhaps, ultimately all the intermediate senses might be found to occupy positions in the gamut of vibration between the last cognisable by the ear and the first by the eye, or rather by the touch in the form of heat.

Mr. ROBERTS mentioned an instance in which sudden danger had been followed by the peculiar taste which results from the introduction of two coins into the mouth, to which allusion has already been made.

Professor FOSTER thanked Dr. Stone in the name of the Society, and expressed a hope that he would continue his suggestive and important experiments.

PROF. G. C. FOSTER called attention to the work of Prof. Everett on the Centimetre-Gramme Second (C.G.S.) system of units, which will shortly be published by the Society. It is designed to facilitate the study of the quantitative relations between the different departments of physical science by the adoption of a common system of hints. Prof. Foster explained that a committee of the British Association, which was appointed in 1872, and of which Prof. Everett was secretary, recommended the adoption of this system, based upon the metric system. The unit of mass being the gramme, that of length the centimetre, and that of time the second. They recommended that the unit of force be called a *dyne*, which therefore, is the force required to act upon a gramme of matter for a second to generate a velocity of a centimetre per second. The unit of work is called an *erg*, and is the amount of work done by a dyne working through the distance of a centimetre. Prof. Everett's book consists of a collection of physical data, reduced to these fundamental terms, so that no other physical magnitudes enter into the expressions, and it cannot fail to prove of the greatest possible value to Physicists.

Prof. Foster then left the chair, which was taken by Dr. Stone.

Dr. W. M. WATTS communicated a paper on "*A New Form of Micrometer for Use in Spectroscopic Analysis*." In determining the position of lines in a spectrum by the use of a micrometer eyepiece or divided arc, it is often difficult to see the cross wires distinctly without admitting extraneous light, which, with faint spectra, frequently cannot be done. Dr. Watts has sought to overcome this difficulty by substituting some one known line of the spectrum itself for the cross wires, and to measure the positions of unknown lines by bringing this index line successively into coincidence with them. Thus, for example, the sodium line, which is present in nearly every spectrum whether it is wanted or not, may be made to move slowly along under the spectrum, and the displacement necessary to make it coincide with the lines to be measured may be determined by the readings of a micrometer screw. To accomplish this a convex lens of about 2 ft. focus is placed in front of the prism of the spectroscope, between the prism and observing telescope, and is divided along a line at right angles to the refracting edge of the prism. One half of the lens is fixed, the other half is made to slide over it by means of a micrometer screw. When the movable half of the lens is in its normal position, the only effect is to alter the focus of the telescope slightly, but when it is made to slide over the fixed half, the refraction of the prism is increased or diminished, and half of the spectrum appears to move over the other half, and the sodium line or any other convenient line of reference can be brought into coincidence with the lines to be measured. The indications of this instrument are reduced to wave-lengths by means of a series of interpolation curves from

the data obtained by observations of the solar spectrum' the co-ordinates of which are wave-lengths and micrometer readings. The author considers the advantages of the instrument to be (1) great precision in results and (2) convenience in use. In illustration of the former quality he quotes 20 readings of the point at which there is coincidence of the lenses. They are remarkably concordant, the mean being 8.34, while the two extreme readings are 8.21 and 8.41.

Prof. GUTHRIE then read a paper "*On the Fundamental Water-waves in Cylindrical Vessels*." He stated that many attempts had been made to connect wave lengths with wave amplitude, and that the most successful of these were by the Brothers Weber, who allowed a column of water to fall into one end of a long trough filled with water; and they ascertained by means of a stop-watch when the crest of the wave reached the other end. Dr. Guthrie has recently made some experiments on this subject in which he employed a series of five vessels, varying in diameter from 5.5 to 23.5 inches. The water in each was agitated in the centre by a disc of wood, by which means the vessel was made to give what Dr. Guthrie called its "fundamental note." He counted the number of times the wave rose in the centre in a minute and he found that amplitude has no influence upon the rate. It should also be observed that the wave effect is not the same as if the field were of infinite extent.

The following are the results he obtained:—

| Diameter of Vessel. | No. of Pulsations per minute. |
|---------------------|-------------------------------|
| 1. 23.5 ins. | 106.5 |
| 2. 17.87 " | 122.7 |
| 3. 14.5 " | 136.0 |
| 4. 12.5 " | 146.5 |
| 5. 5.5 " | 219.0 |

From which he deduced the curious result that a constant quantity (517.5) is obtained by multiplying the square root of the diameter by the number of pulsations. The question of depth was also carefully considered, and it was ascertained that the number of waves increases slightly with the depth.

Mr. S. C. TISLEY read a paper on a "*New Form of Magneto-Electric Machine*." After briefly describing the machines which have hitherto been devised, he stated that the new apparatus consists essentially of an electro-magnet with shoes forming a groove, in which a Siemens' armature is made to revolve. It differs from the original machines made by Siemens and Wheatstone in the commutator, as two springs conduct the current from the cylindrical insulator, to which are attached three pieces of metal, one surrounding it for three quarters of its circumference, the second for one quarter, and between these is a third ring insulated and connected with the insulated end of the wire from the armature, and bearing two pieces of metal which are so arranged as to complete the circles of the outer pieces of metal. The armature is so constructed that a stream of water may be constantly passed through it.

A small machine constructed on this principle which, without its driving gear, weighs 26-lbs., is capable of raising 8 inches of platinum wire 8 inches long and 0.005 inch in diameter to a red heat.

The meetings of the Society were then adjourned until November.

Method of Discovering the presence of Nitrous and of Nitric Acids in Water.—Hermann Kaemmerer.—The author adds first acetic acid and a solution of starch in iodide of potassium. If the water turns blue, nitrous acid is present. If it remains colourless, add a few drops of sulphuric acid. A blue colouration which darkens rapidly proves the simultaneous presence of nitrates and of easily decomposable organic matter.—*Moniteur Scientifique*.

SOCIETY OF PUBLIC ANALYSTS.

INFLUENCE OF PHOSPHORIC AND OXALIC ACIDS ON THE COLOUR OF SULPHOCYANIDE AND MECONATE OF IRON.

By A. DUPRÉ, Ph.D., F.R.S.

DURING the discussion on Mr. Young's paper, "On the Volumetric Estimation of Chlorides, &c.," I took occasion to describe, shortly, Volhard's* admirable method for the estimation of silver and of chlorides in an acid solution. Volhard uses sulphocyanide of potassium as the precipitant, and takes persulphate of iron as the indicator. I stated, at the same time, that I had found the presence of phosphates interfered somewhat with the beauty of the reaction. I have since examined this point a little more closely, and believe that the results are not without some interest. The effect of oxalic acid on the red colour of the sulphocyanide of iron, viz., that of destroying it, is already known, but I am not aware that the other effects about to be described have previously been noticed.

If, to a dilute and moderately acid solution of a per-salt of iron, we add an equivalent proportion of a sulphocyanide, the well-known blood-red colouration is, of course, obtained. On now adding a solution of either a phosphate, pyrophosphate, or metaphosphate, or of the respective acids, the red colour may be entirely destroyed, even by the addition of comparatively small amounts of these substances. The influence of ordinary phosphates is least, the nature of the base exerting apparently no influence; pyrophosphates are more powerful; and, lastly, metaphosphates are most powerful of all. The effect of metaphosphoric acid I have found to be about five times more powerful than that of corrosive sublimate; unfortunately, it destroys the colour of the meconate as well. If not more of these substances than just sufficient for the destruction of the red colour has been added, the red colouration may, to a slight degree, be restored by the addition of either more acid or more sulphocyanide; but even the addition of a large excess of one of these has, comparatively speaking, but little influence. On the other hand, the addition of more per-salt of iron brings back the colour much more readily, and, indeed, a large excess of iron salt almost restores it to its original intensity.

It follows, from the foregoing, that, in testing for traces of sulphocyanide in liquids containing phosphates, it is necessary, either to remove the phosphoric acid, or else to add a very large excess of iron salt; and as the persulphate of iron is, in acid solutions, perfectly colourless, this latter expedient may generally suffice. I think it not unlikely that the presence of sulphocyanide in saliva has sometimes been overlooked, owing to its also containing phosphoric acid. In his titration, Volhard recommends the addition of a very large excess of iron salt as indicator, since in an acid solution the intensity of colour produced by a given proportion of sulphocyanide is the greater the larger the amount of iron present. In this way, the influence of any phosphoric acid present is also reduced to a minimum.

Oxalic acid, or oxalates, have also, as has already been noticed, the power of destroying the red colour of the sulphocyanide of iron.

Seeing the strong effect of these acids on the red solution of sulphocyanide of iron, I examined their influence on the similarly-coloured meconate, and found them equally effective in destroying the red colour of the latter. Here, also, meta-phosphoric acid had the greatest effect, next came pyrophosphoric, and, lastly, ordinary phosphoric.

Now, in the ordinary method employed for the detection of meconic acid in organic mixtures, in cases of suspected

poisoning by opium, the acid is precipitated by means of acetate of lead. The meconate of lead obtained is next decomposed by means of sulphuric acid or sulphuretted hydrogen, and the solution thus obtained is tested for meconic acid by means of perchloride of iron. It will now be obvious that this method is open to grave objections. The organic liquids to be tested will almost always contain phosphoric acid, which will, of course, be obtained, together with the meconic acid, and may entirely prevent the action of the iron test if traces of meconic acid only are present, as will usually be the case. Fortunately, it is only ordinary phosphoric acid which is likely to be met with in such cases; nevertheless, it is, I think, extremely advisable to remove the phosphoric acid before testing for meconic acid. Oxalic acid, if present, would, like the phosphoric acid, be obtained together with the meconic acid, and would, like this acid, prevent the proper action of the iron test.

In the cases of pyro- or meta-phosphoric acid, the above reaction can be shown conveniently in somewhat dilute solutions only, since both these acids yield, with per-salts of iron, precipitates which are much less soluble in acids than the ordinary tribasic phosphate.

CORRESPONDENCE.

DOUBTFUL MINERALS, &c.

To the Editor of the Chemical News.

SIR,—“Fortunately, anywhere, cats may look at kings.” In my last communication, I promised to be more concise. I cannot, however, keep the promise; for Professor Dana, as you know, has taken me to task. In due courtesy to him, I am obliged to reply to the best of my ability, and the subject does not admit of condensation into chemical formulæ.

It is of the nature of Tar to get more fluent as the weather warms, and, I hope, on this time, not to offend “in criticism, whether from a literary, æsthetic, or scientific point of view.”

In the sublimity of simplicity, a Tartar cat looked up at two kings, and the kings in their turn looked down at the cat. One stroked the right way, and called him “good-humoured;” the other the wrong way, and dubbed him “uncivil,” creating thus, another provoking instance of the Dual nomenclature, to which I have presumptuously taken objection.

In his letter of April 9th (CHEMICAL NEWS, vol. xxxi., p. 160), Professor Dana writes:—“T. A. R. gives me more credit than is my due; and, in an uncivil way, brings me into collision on a point of trifling importance with the excellent mineralogist of the British Museum, Professor Maskelyne.”

To these allegations, in a sort of legal way, I shall plead “Not Guilty, and extenuating circumstances.”

The venerable Professor's letter challenges a little fencing; but before I touch a foil, allow me to premise that, if I have not already written enough to indicate the high appreciation I entertain of both these learned mineralogists, I am willing to go still further, and in frankness say that I regard them both as of Nature's true nobility. To a very high esteem for both, I add no low degree of reverence for the veteran Dana. Both have earned their titles to honourable distinction. Their titles are “Dana,” and “Maskelyne;” names not in the least likely to be taken to mean either the same thing, or any other bodies, and it is my desire that nobody shall have the audacity to turn them into mutilated Greek or hybrid names for “universal use.”

Initially and otherwise, perhaps, I may be taken for a very soft thing; but I have a habit of showing my respect to eminent men, and “sisters of mercy,” by uncovering my head whenever I meet them. I should

* J. Volhard, *Journal für Prakt. Chem.*, 1874, ix., p. 217.

do this to Dana and Maskelyne, although they would not know me from Adam. Indeed, I half love the Basle people for once having made it a part of the education of every child to take off the hat to Daniel Bernouilli, the mathematician. It is exquisite enjoyment to pay old-fashioned proper respect to respectable people, whether "to greatness born," or not—I mean the truly noble—all those who befriend mankind.

The following are the chief points in Dana's communication:—

- (1). That I give him more credit than is his due.
- (2). That, in an "uncivil" way, I have brought him into collision on a point of trifling importance with Maskelyne.
- (3). That the system in mineralogical nomenclature is not of his making.
- (4). That by implication I make out Bendant, Haidinger, Von Kobell, Nicol, Greg, and Lettsom, to be "all alike blockheads," because they have called copper pyrites chalkopyrite.
- (5). That, in the adoption of the scientific names of minerals used in his treatise, he has simply followed the best authorities, and "the usual Law of priority."
- (6). That the objection urged to names from a Greek or Latin source, is the old one of "uninformed" minds against all scientific nomenclature.
- (7). That the object secured by such names is "uniformity the world over, through all languages."
- (8). That nearly all recent mineralogical authors have adopted, and that "science has accepted *Chalkopyrite* for universal use," in lieu of copper pyrites.

Now since the tickle of a feather is always more or less an agreeable irritation, and "the dread and fear of kings" not being heavy on me, I propose to stick closely to the subject in hand, and, careless alike of praise or blame, plainly say what I think upon it in this reply.

In the first place, Dana heads his letter "Doubtful Minerals," and says not a word about them afterwards. About "Dual nomenclature" he scarcely touches the fringe of the argument: yet, what he has written, he has written, and, from his writing, I take the diploma of "excellent," bestowed on Maskelyne as a kind of strengthening mixture for my defence.

Dana dexterously touches my hamstring, and has a little the best of me, in one respect, in the wrestle about the fair fame of chalkopyrite. Had I selected "*Halite*" or "*Sphalerite*," for my figure of speech, possibly he would not have written at all; therefore I may good-humouredly chuckle over the fact that my experimental cablegram has been the means of bringing the two mineralogical kings into verbal, and, I hope, not uncivil, collision.

To the enumerated points of Dana's letter I venturously reply:—

- (1). I cannot give him *too much* credit for his life of honourable labour.
- (2). It is not appropriate to label me "uncivil" in this matter. I cannot bring my mind to consider the subject of Dual mineral nomenclature one of "trifling importance." I hold it still to be the very reverse of "trifling." But, if really trifling, then all scientific bothers should be viewed as trifles, and tangled yarn the delight of weavers.

(3). I have not hinted anywhere that Dana is "the author of the system in mineralogical nomenclature:" for literally there is in it really no system at all.

The total want of system is simply discreditable to the scientific age we live in, and to the whole body of its mineralogists. I do not, however, hesitate to declare openly that my venerated teacher has been the author of a good deal of the present "confusion of tongues" in mineralogical nomenclature, his laborious efforts to the contrary, notwithstanding.

But the goal to which I am agonising is not whether Dana or Maskelyne's nomenclature is to be, or what other system should be, preferred. The object I am feebly aiming at is to get an end put to the present inconvenient diversity of use, and now that I have wired together the only two intelligences that can readily effect this desideratum, I am quite buoyant with expectation and cheerful hope.

(4). I shall be excused for saying that it is scarcely regal to parody the speech of low intelligence, and to put "blockhead" into my hand to hurl at Bendant, Nicol, and others my superiors. I never could apply the damaging epithet to them, for all in their turn, as well as Dana, have instructed me.

It is fact that the authors cited by Dana used chalkopyrite for copper pyrites; but, it is also fact that copper pyrites was the expression used by Allan, Jameson, Chapman, Thomson, Phillips, Gmelin, Bischoff, in Ure's "Dictionary," in Watts's "Dictionary," in the recent mineralogical offshoots from Jermyn Street (of Ramsay, Rudler, and Jordan), by Maskelyne at the British Museum, and *mirabile dictu* by Dana himself prior to 1868!

I am too far off the British Museum Library, or I would ascertain by what name Dana called copper pyrites in the first, second, third, and fourth editions of his "System of Mineralogy." It is sufficient, however, for my purpose to state that in his "Manual of Mineralogy," 1863 and 1867, he uses copper pyrites always, and chalkopyrite *never*!

In 1725, Dana's authority, *Henckel*, called copper pyrites, pyrites *flavus*, although he also appears to have suggested that the adjective *flavus* should be put into Greek, as *brass*. *χαλκος* was thus made to depose *flavus* unnecessarily, and withal to carry an erroneous idea along with it. It will not be denied that both pyrites *flavus*, and copper pyrites, have the appreciative merit of vivid directness of expression, which chalkopyrite has not and never can have. A student can seize and hold forceps-like, the idea involved in them; but not so in chalkopyrite. A Folkestone man might feel inclined to take the latter for pyrites o' th' chalk. I do not say that he would do so. It would appear as useless to contend for the appropriateness of chalkopyrite, as of that hybrid "*gold-brass*," aurichalcite.

(5). I am entitled to ask who are the *best* mineralogical authorities of the past? and who instituted the law of priority? This law of priority upon which Dana lays such peculiar stress, is evidently unlike the law of the Medes and Persians, for Dana himself is not very rigid in his adherence to it. In 1868 he rejects the

Augite of *Wern*, 1792, for Pyroxene of *Häuy*, 1801.

Hornblende of *Wern*, 1789, for Amphibole of *Häuy*, 1801.

Steatite of *Kirn*, 1794, for Saponite of *Svanberg*, 1840.

Mispickel of 1747, for Arsenopyrite of *Glock*, 1847.

Meerschaum of *Wern*, 1788, for Sepiolite of *Glock*, 1847.

Anatase of *Häuy*, 1801, for Octahedrite of *Wern*, 1803.

Pitchblende of old, for Uraninite of Dana, 1868.

Tin Pyrites of *Kirn*, 1797, for Stannite of Dana, 1868.

Blende of old, for Sphalerite of *Glock*, 1847.

Galena of *Pliny*, for Galenite of *v. Kob.*, 1858.

Mimetesite of *Breith.*, 1841, for Mimetite of *Haid.*, 1845.

Berzelite of *Levy*, 1837, for Mendipite of *Glock*, 1839.

Rock Salt of old, for Halite of Dana, 1868.

Tungstic Ochre of *B. Silliman*, 1822, for Tungstite of Dana, 1868.

Sulphuric Acid of old, for Sulphatite of Dana, 1868.

Nickeline of *Bend.*, 1832, for Niccolite of Dana, 1868.

Delvauxene of *v. Hauer*, 1854, for Borickite of Dana, 1868.

The transmutations of horn silver are interesting. It became Kerargyre under *Bend.*, 1832; Kerat under *Haid.*, 1845; Argyroceratite under *Glock*, 1847; Kerargyrite afterwards, under Dana, and Chlorargyrite (as now)

under *Maskelyne*. In 1868 *Dana* put forth *Ketarargyrite* as the proper derivative, changed the Greek κ into c , and let go the word *Cerargyrite* for "universal use."

I may here remark that *Dana* has not always been faithful to his own decisions, e.g., the *Sylvanit* of *Neck.*, 1835, was changed by *Dana* in 1837 to *Aurotellurite*, and reinstated as *Sylvanite* in 1868. *Emplektite* of *Kenng.*, 1853, was made *Tannerite*, 1854, and *Emplectite*, 1868. *Feuerblende* of *Breith.*, 1832, made *Fireblende*, 1850, and *Pyrostilpnite*, 1868. *Plumbo-gummite* of *Shep.*, 1835, made *plumbo-resinite*, 1837, and again *plumbo-gummite*, 1868. *Melinophane* of *Scheerer*, 1852, made *Meliphane* by *Dana*, 1867, and changed for *Meliphanite*, 1868.

The "limitations" of the law of priority appear to have been needlessly infringed in the following instances, viz.:—The *Olivine* of *Werner* for *Chrysolite* of *de Lisle*. *Amber* of recent centuries, for the *Succinite* of *Pliny*. *Idocrase* of *Hauy*, for *Vesuvian* of *Werner*, and the *Sphene* of *Hauy* for the *Titanite* of *Klaproth*. The *Fluor* of our lifetime for the *Fluorite* of *Napione*, 1797. (*Dana* himself using *Fluor Spar* familiarly in description. *Syst. Min.* p. 125.) Lots appear to have been drawn for precedence in the case of the *Wernerite* and *Scapolite* of *d'Andrada*, of 1800. *Scapolite* has since been in general use; but in 1868 *Dana* substituted *Wernerite*, although he writes familiarly of *Red and Black Scapolite* afterwards (*Syst. Min.*, p. 134), and in "Manual," 1867, cites *Scapolite*, adding (p. 181) "*Nuttalite*, *Wernerite*, and *Glaucolite*, are varieties of this species."

Although *Dana* asserts the Greek language to be the most approved source of names, he occasionally compliments persons and places. *Silicoborocalcite*, he economically transforms to *Howlite*. The *Binnite* of *C. Heusser*, 1855 (the *Arsenomelan* of *Petersen*, 1866), appears to have been turned into *Sartorite* out of compliment to *Sartorius v. Walterhausen*, because he announced the mineral as *Skleroklas + Arsenomelan*. See also *Dana's Tavistockite*, *Urpethite*, *Azorite*, *Zietrisikite*, &c.

It seems barely consistent to eject the English word "stone" from mineralogical science, and to take up instead the Greek "*lithos*." Still less consistent to employ the artist who chiselled somehow *Bob* out of *Robert*, to make *ite* and *yte* out of *lithos*, as suffixes for universal use in mineralogical and geological nomenclature.

Yet this revolution has been effected and graciously submitted to because none are misled by it. Indeed, they have their uses, although in them the least possible is left of the original Greek, and the law of priority is scouted. But "*Carbohydrogens*" are *not all stones*, and it is therefore difficult to see distinctive alterations for the better in *Dana's Butyrellite*, *Glocerellite*, *Brücknerellite*, *Succinellite*, *Melanellite*, *Retinellite*, *Cryptolinite*, &c.

Again, *who are the best authorities*, and *who is to decide*, when great doctors differ?

E.g., *Dana's Calamine* (a zinc silicate) is the *Smithsonite* of *Brooke* and *Miller*, and of *Greg* and *Lettsom*, and the *Hemimorphite* of *Maskelyne*.

Dana's Smithsonite (a zinc carbonate) is the *calamine* of *Brooke* and *Miller*, *Greg* and *Lettsom*, and of *Maskelyne*. (A student feels dangerously safe on this ground.)

(6). Here *Dana* does me injustice. It would indeed be absurd to object to appropriate scientific names from a Greek or Latin source. I have never made such an objection, and I hope I shall not live to make myself half so ridiculous. Ardent lovers of such names can flounder about in palæontology to their hearts' content, or otherwise.

The stand I make for the retention of *Common Salt*, *Blende*, *Copper Pyrites*, *Amber*, &c., is precisely for the reason assigned by *Dana* for his retention of *Quartz*, *Diamond*, *Garnet*, *Gypsum*, *Realgar*, *Orpiment*, &c., namely, that these words have become part of general literature, and, more or less, this may be made reason-

able ground of objection against the wholesale alterations made recently by *Dana* in mineral nomenclature.

Although, years ago, malignant typhoid stripped my head of its hair, and took along with it a good deal of my Greek and Latin, yet I am still tolerably able to make out the derivation of words *intelligently* compounded of either of these languages; but I defy the very Pope himself, with the assistance of *Gladstone* and *Lowe*, to make head or tail as to the derivation of some of the existing *skye-terrier* names of minerals. I warrant they would all square at *Melopsite*, *Pyrophysalite*, *Zeagonite*, *Sphalerite*, *Gymnite*, *Æschynite*, *Isopyre*, *Neotokite*, *Allophanite*, *Monazite*, *Diadochite*, *Euxenite*, *Chalkopyrites*, and a hundred others. (The biting a bit off the tail of the last-named helps them but little).

I am obliged, however, reluctantly to admit, that to a very great extent my mind is still "uninformed" mineralogically, although I have been a diligent and faithful disciple of *Dana* nearly ever since he took to "typogram." I think I have read close upon everything mineralogical that he has published. I paid willing homage to him as to a mineralogical pope until the promulgation of his "Vatican Decrees." Finding, in 1874, that his infallibility dogma interfered seriously with the allegiance to my own lawful and gracious Sovereign, I did but adopt the *Gladstonian* expostulation policy, and took to toasting *Maskelyne* first, and *Dana* "first afterwards," as to mineralogical nomenclature.

(7). I am entirely in accord with *Dana* on this point. *Pio Nono* says the same of theological Latin. But protestants say important language should be "understood of the people."

(8). On this head I am not in accord with *Dana*, for reasons already stated.

In conclusion, the "extenuating circumstances" are mainly—(1) The obligation of double-duty imposed upon me and other mineralogical students by *Dana's* "System of Mineralogy" (1868); (2) the natural irritation I personally felt, after waiting half-a-dozen years for a new edition of *Dana's*, at being induced by an advertisement of *Trübner and Co.* to purchase, for 35s., what purported to be a new edition, and finding in it only nineteen pages of supplementary matter not worth one tenth of the money.

Being only an obscure mineralogical student, and not a teacher of science, as *Dana* appears to apprehend, I take the liberty now of referring to certain works of his and of *Maskelyne's* creation, viz.:—*Dana's* "Manual of Mineralogy," 1867; *Dana's* "System of Mineralogy," 1868; and *Maskelyne's* "Index to the Collection of Minerals in the British Museum," 1872.

In the "Manual" of 1867, I find the six crystallographic systems appearing in the following order:—(1) Monometric, (2) dimetric, (3) trimetric, (4) monoclinic, (5) triclinic, (6) hexagonal.

In the "System" (1868), I find the order running:—(1) Isometric, (2) tetragonal, (3) hexagonal, (4) orthorhombic, (5) monoclinic, (6) triclinic; and the following apologetic note at p. 21:—"The names monometric, dimetric, and trimetric, used in former editions of this work, have been set aside for the above, for two reasons—(1) the fact that the names want precision, the hexagonal system being as much *dimetric* as the tetragonal, and the monoclinic and triclinic as much *trimetric* as the orthorhombic; (2) the desire to promote uniformity in the language of science. The names employed appear to be the best that have been proposed, and those most generally used, and, hence, those that have the best claim for universal adoption."

I have before me just thirty-two systems of crystallography, including those of *Dana*, and I am bound to say that I think the system proposed by *Dana* in 1868 is a great improvement upon all that preceded it, although the atmosphere of hexagonal crystals is still somewhat hazy to ordinary students. But I cannot refrain from asking why the "Manual," which is largely in use in this country,

and, I suppose, also in America, is allowed to remain in this extraordinary state of difference with the improved "System?"

In proof that dual nomenclature is not a thing of such trifling importance as Dana puts it, I beg reference to Appendix A, which is a list of names of certain mineral species which Maskelyne, in his "Index," uses at the British Museum, and for which Dana has substituted entirely different words, by resurrection and otherwise.

In Appendix B I have, once for all, given a sickening long-list of "Doubtful Minerals," to be found scattered up and down our mineralogical literature. Doubtful, in some cases, wanting only further authentic particulars; doubtful, in others, to the very verge of disbelief in their existence, either at the present or at any other time.

Just one hundred years ago, Dr. Nevil Maskelyne, the Astronomer Royal, went to the mountain Schiehallion, in Perthshire, ostensibly to weigh it; but, literally, to weigh the whole earth, and he actually did so, almost to a nicety. "The excellent mineralogist of the British Museum, Professor Maskelyne," since that time has learned a vast deal of the chemical constituents of the earth, and how delicately to measure the beautiful crystal gems of it. I would politely suggest to him this as a very fitting opportunity for observing the centenary of his celebrated ancestor's great achievement, by initiating the re-construction of mineral nomenclature, and the dispersion, or otherwise, of this host of "Doubtful Minerals."

To the revered Dana, and his talented heir apparent, Professor G. J. Brush, allow me to put forth a little of the very tenderest of provocation. I would petition in the most humble and delicate manner possible.

Re-cast your "Woolwich infant" of 1868, and try it with powder that has not been quite so long in store. The new cubic system appears a great improvement on the old. Your field-piece of 1867 can be very easily rifled. In mercy to suffering humanity, whose life, at longest, is but short, rifle the one, re-cast the other, kill or cure us, and make an end of our miseries. Agree to an honourable compromise, as regards dual nomenclature, post up to date what is known of the merits or demerits of the doubtful minerals, gavanise into fresher life the legitimate orphans, shoot down the factious pretenders, bury them decently, and let them be clean and everlastingly forgotten, and your humble petitioner will for ever pray, &c.—I am, &c.,

T. A. R.

APPENDIX A.

Allochroite, Alstonite, Alum, Amber, Anatase, Augite, Barytes, Bismuthine, Bismuth Ochre, Bleinierite, Blende (Zinc), Bog-butter, Boronatrocalcite, Bromargyrite, Calaita, Calamine, Chalybite, Chlorargyrite, Cobalt Glance, Copper Glance, Chessylite, Crocoisite, Cromfordite, Cryolite, Dichroite, Erubescite, Fluor, Galena, Glaserite, Gymnite, Hamartite, Hemimorphite, Hornblende, Idocrase, Iodargyrite, Keramohalite, Kühnite, Laumonite, Lettsomite, Lievrite, Meer-schaum, Melanochroite, Mimetisite, Mispickel, Molybdic Ochre, Nickel Glance, Nitratine, Nickeline, Olivine, Onofrite, Orthite, Pennine, Phosphorochalcite, Pitchblende, Plumbosininite, Pyrites (Iron), Pyrites (Copper), Ripidolite, Salt, Scapolite, Silicoborocalcite, Sphene, Steatite, Texasite, Tungstic Ochre, Völknerite, Websterite, Wolfram, Wolfsbergite, Ytterite.

APPENDIX B.

DOUBTFUL MINERALS, REQUIRING EXTINCTION OR FURTHER AUTHENTIC DESCRIPTION.

Acanthoide, Acnite, Acrusite, Adelpholite, Ænigmatite, Alm, Almagrerite, Alumina (Native), Amausite, Amblystegite, Ambrosine, Amianthoide, Anchosine, Antholite, Antimony (Native), Antillite, Antimonphyllite, Antozon Bleiglanz, Apatoid, Apjohnite (Glock), Aquacryptite, Aræoxene, Argillomurite, Antimonial Arsenic (Schultz), Arsenic Hydride, Arsenic Glance, Aspidolite (v. Kob.), Atelesite, Atlasite, Atacolite, Augelite, Bagrationite (Hermann), Bezoar Mineral, Bolivianite, Boloretine, Bombite, Boron (Graphitoidal), Breadalbanite, Brewsterlinite, Bucaramangite, Bucaramanga Resin, Cabocle, Cabrerite, Cadmia, Calcoferite, Caliche, Caliphite, Calstronbaryte, Calyptolite, Canoxinite, Cantalite, Carnat, Carnatite, Carrollite, Cassinite, Castellite, Castillite, Catalina Stone, Celestobarite, Centralagrite, Cerinite, Chalchithnitl, Chantonite, Chionit, Chladnite, Chlorite Earth, Chlorolisthene, Christianite, Chromochroite, Chromchlorite, Chrystophyllite, Claussenite, Clayite, Cobalt Nickel Glance, Cobalt Scorodite, Conichrite, Conistonite, Copperasine, Copper Diaspore, Copper Pitchblende, Corn Spar, Cottaite, Cotton Stone, Coulobrasine, Craie de Brianzon, Crucite (Thomson), Crucite (La Metherie), Cryptolinite, Cubanite, Cuivre Speciforme, Culebrite, Cumengite, Cupriferous

Marlite, Cyanochroite, Cyanolite, Cyrtolite, Dalarmite, Decatrylene, Decatylene, Delarnite, Delawarite, Deleminozite, Dinite, Dipyrte, Dopplérite, Dumasite, Duttonstein, Dyripe, Dyslilite, Eagle Stone, Elhuyarite, Ephesite, Epiglaubite, Epiphosphorite, Erlanite, Erusibite, Eschwegite, Eucolite-Titanite, Eukamptite, Euphotide, Fauserite, Feitzue, Ferrite, Ferrocaltite, Fieldite, Fossil Caoutchouc, Fossil Carbon, Fournetite, Galapectite, Gehlenite (massive), Geyerite, Gibsonite, Grahamite, Grammatite of Aker, Granitine, Grorolite, Grothite, Guanoxalate, Gummitc (Breith.), Halloyrite (St. Jean de Cole), Hamartite, Hampshirite, Harringtonite, Harrisite (Genth), Hartine (Schrötter), Hayerine (D. Forbes), Heddlite, Helminth, Helmintholite, Helvetan, Hematoconite, Herderite (Haid.), Herrerite, Hessenbergite (Dana), Hopeite, Hovite, Howardite, Huyssenite, Hoerlera, Hyblite, Hydroapatite, Hydrocalcite, Hydrophilite, Hydrosilicite, Hypoxanthite, Hystatique (Breith.), Idryl, Ildeforsite, Indian Red, Iodolite, Ioguneit, Iridium (Krantz), Jalpaite, Jaulingite, Jelletite, Jenzschite, Joketan, Jollyte, Jossaite, Kabook, Kainite, Kalicine, Kaliphite, Kalyplotite, Keffekil Tartorum, Keityoit, Kerstenite, Kevil, Kinsigite, Kir, Klapperstein, Konilite, Koodilite, Koreite, Korite, Koth, Leedrite, Lennilite, Lenzinite, Leptonemerz, Leucaterite, Leucocyclite, Lentrite, Lherzolite, Lignite Resin, Ligu-rute, Livingstonite, Lodulite, Loganite, Luscite, Magnet (Native), Mamanite, Mancinite, Marasmolite, Marcyllite, Margode, Mariatite, Melaxoite, Melinite (Glock), Meroxite, Mesolin, Metaxoite, Meteoric Dust, Meteorokies, Miaskite, Micarelle, Michaelsonite, Miloschite, Moffrasite, Molybdänuran, Morpholites, Mother of Diaspore (Watts), Mourolite, Muldan, Myelin, Mysorine, Nacrite (Vaquelin), Nantokite, Native Coke, Native Steel, Neftgil, Neofese, Neotype, Nepaulite, Nephrolite, Nickel Vitriol (Hunt), Nickelthoneisenzinksilicat, Nitramite, Nitrogenous Hydrocarbon, Nitromagnesite, Noralite, Nordmarkite, Norwich Mineral, Notite, Nova Mina, Odontolite, Oktibelrite, Olafite, Oro Pudre, Oserskite, Palladinite, Paraluminite, Paraisite, Parastilbite, Parophite, Passauite, Pattersonite, Pelhamite, Pencalite, Pencatite, Pencil Stone, Pessilite, Petrolene, Pettkoite, Phthamite, Phyllin Glance, Phylloretine, Picrofluite, Picropharmacolite, Picrotanite, Picrotephroite, Piddingtonite, Pigotite, Pinitartigen (Watts), Pittinite, Plakodine (Breith.), Plata Verde, Plattnerite, Plessite, Plombeine, Plombrerite, Polyhalite de Vic, Polylite, Portite, Potash Copperas, Prasilite, Prasochrome, Predazzite, Protheite, Protherite, Protobasite, Przbramite, Pterolite, Pyrophane, Pyrrholite, Rancierite, Rardionite, Ratofkite, Rauchkalk, Raumite, Refdanskite, Rcfikite, Reissite, Retzbanyite, Rerodanskite, Richmondite, Rionite, Roepperite, Roepperite (G. J. Brush), Roesmerite, Sandbergite, Santorine, Saponite (Nickles), Scacchite, Schapbachite, Schefferite, Schlaken, Schønite, Schweruranerz, Scleroclase, Scolerose, Scorilite, Scortite, Scotine, Selenium (Native), Sericite, Sericolite, Serpentinite, Sexangulite, Shepardite, Sideroschisolate, Sideroclept, Sideroferrite, Siderographite, Siderosilicate, Siderosbole, Silbeloit, Skorian, Skogbœlote, Skorolite, Slaggy Mineral Pitch, Slaggy Augite, Smelite, Soda Tungstate (E. Pool Mine), Somaite, Somnite, Spartaite, Sphenomatite, Spherite, Sphragidite, Staffelitoid, Steargilite, Steel Cobalt, Stephensonite, Stibilite, Stolpenite, Strontianocalcite, Studerite, Sulphatite (Dana), Szaibelyte, Talcoïd, Tanah-ampo, Tantalum Ochre, Targionite, Taugiwaite, Tauriscite, Tautocline, Tectite, Tekoretin, Tellurite (Nicol), Thierschite (Liebig), Thomaite, Tiger Ore, Timazite, Tinder Ore, Tiza, Traversella, Trichite, Triclasite, Trinacrite, Tuesite, Turba, Uddervallite, Ugite, Unionite (Oligoclase), Uranoniobite, Vanadic Ochre, Vanadineizenerz, Vanadin-Molybdaublei, Variolite, Variscite, Vermontite, Verrucite (Apjohn), Vestan, Vestan Cobalt, Vignite, Vitrinopal, Vitriolite, Lime Voglianite, Volgerite, Wærthite, Wagite, Walmstedtite, Wasite, Wehrlite, Wiserite, Wocheinite, Wodankies, Wollongongite, Xylocryptite, Xylotile, Yabicoja, Ypoleime, Yttria (Silicate), You (Chinèse), Zamtite, Zavalite, Zeasite, Zeugite, Zeuxite, Zincazurite, Zinkosite, Zorodon.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 23, June 14, 1875.

Researches on the Solar Radiations.—M. P. Desains.
—Not adapted for abstraction.

Synthesis of Camphors by the Oxidation of Camphenes.—M. Berthelot.—This synthesis was imperfectly effected in 1858 by means of platinum-black. In 1869 the author used pure chromic acid, and was thus able to isolate the camphor furnished by the oxidation of the camphenes in larger quantities and in a greater state of purity. M. Ribau has effected the conversion in a similar manner.

Opinion of the Commission on Lightning Conductors on a New Arrangement proposed for Powder Magazines.—The Minister for War consulted the

Academy on the project of fitting up powder magazines with ventilation-shafts, resembling chimneys. A Commission selected to investigate the question concluded that such chimneys would not become sources of especial danger in case of thunderstorms, but pointed out certain precautions to be observed in their construction. It was especially recommended that no pieces of metal should be inserted, which, if a flash of lightning struck the adjacent conductors, might give rise to induction-sparks.

Synthesis of a Terpine or Camphenic Carbide.—M. G. Bouchardat.—The author, on submitting isoprene in sealed tubes to a temperature between 280° and 290°, for ten hours, in an atmosphere of carbonic acid, found the appearance of the liquid entirely changed. On distillation three principal products were collected,—a certain quantity of the original carbide unaltered, a carbide volatile between 170° and 185°, and products of condensation with higher boiling-points. The largest portion distils at 176° to 181°, and has the composition $C_{20}H_{16}$.

Theory of Dissolution and Crystallisation.—M. Lecoq de Boisbaudran.—A criticism on the views of M. Pfaundler, as given in the *Bulletin de la Societe Chimique*, June 5, 1875, p. 491.

Gazzetta Chimica Italiana, Anno v., Fascicolo 3, 1875.

Action of Chloride of Acetyl upon Santonic Acid and upon Santonin.—Fausto Sestini.—By the reaction of chloride of acetyl upon santonic acid, the author attains monoacetyl-santonin acid, $C_{15}H_{19}(C_2H_3O)O_4$. The ether which has been employed to wash the acetyl-santonin acid deposits, on evaporation, a white substance of an acid reaction, melting at 126° to 128°.

On Certain α -Toluylic Derivatives.—C. Colombo and P. Spica.—The authors obtain α -toluylic sulphamide in colourless prismatic crystals, insoluble in water, but soluble in alcohol and ether, and melting at 98°, whilst its isomer—obtained from paratoluic nitrile—melts at 168°.

Formation of Sugar in Fruits.—M. Mercadante.—In the first period of their existence fruits behave like leaves, decomposing carbonic acid under the influence of the sun's rays, and giving out oxygen. In the second period they absorb oxygen and give off carbonic acid. In the third the sugar which they contain passes into the alcoholic fermentation. On the 20th of May the author began to determine the acidity and the sugar in green plums. The acidity and the sugar were found to increase very sensibly. The branches contained no other acid than the malic, accompanied by pectic and gummy matters. The fruit behaved exactly like leaves with respect to the air, giving out oxygen by day and absorbing carbonic acid. Continuing his analyses he found that the maximum acidity was when the fruit began to give off carbonic acid by day. It contained then 2.76 of malic acid in 100 of pulp. The sugar is derived from the prolonged action of the malic acid upon the gummy matter, which in the earlier analyses amounted to 6.21 per cent of pulp, but in the second to 3.34, at which quantity it remained nearly constant, 3.27 per cent of gum being still found on July 18. The successive changes in the amounts of sugar and malic acid are shown in the following table:—

| | Sugar. | Malic Acid. |
|---------------|--------|-------------|
| June 20 | 16.52 | 2.76 |
| „ 24 | 16.64 | 2.46 |
| „ 30 | 16.78 | 2.16 |
| July 4 | 17.048 | 1.57 |
| „ 12 | 17.38 | 0.82 |

The acids themselves thus appear to be transformed into sugar.

New Method of Determining the Tannic Acid in Wines.—Antonio Carpehe.—The author precipitates the tannin with ammoniacal acetate of zinc containing a large excess of ammonia.

Justus Liebig's Annalen der Chemie.
Heft 1, May 26th, 1875.

Investigations on Hypochlorous Acid and Euchlorines.—L. Pebal.—The author concludes from his experiments that the views of H. Davy and Gay-Lussac, as to composition of hypochlorous acid is correct. The molecular weight of the gaseous substance, putting that of hydrogen $H_2=2$ is $= 67.29$, and its molecular formula is ClO_2 . The boiling point of liquid hypochlorous is $+9^\circ$, and not about 20, or even 32° . Euchlorine is a mixture of ClO_2 and free chlorine. The relative proportions depend on the mode of its preparation. Millon's conclusions as to the existence of a compound Cl_6O_{13} depend on erroneous assumptions.

Application of Quantitative Spectral Analysis to Methods of Titration.—K. Vierordt.—Reserved for insertion in full.

Reaction of Bromide of Ethylen with Dilute Alcohol in Presence of Acetic Glycol-Ether.—Eugene Demole.—Not adapted for abstraction.

Communications from the Griefswald Laboratory.—These consist of a paper on a new amidosulphotoluic acid, by Dr. M. Hayduck; a memoir on nitrosulphobenzolic acids, by H. Limpricht; on the amidosulphobenzolic acids, by H. Limpricht; on α -amidosulphobenzolic acid, by Dr. A. Berendsen; and on γ -amidosulphobenzolic acid, by A. Berendsen and H. Limpricht.

On Octylactinic Acid and its Nitrile and Amide.—E. Erlenmeyer and O. Sigel.

Origination of Amidocaprylic Acid.—E. Erlenmeyer and O. Sigel.—These two papers do not admit of useful abstraction.

Moniteur Scientifique du Docteur Quesneville, June, 1875.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.—In treating of improvements in mineral colours the author mentions that the arseniate and arsenite of alumina are now extensively used in the preparation of lakes instead of free alumina, yielding products more pure and brilliant, but objectionable from a sanitary point of view. The madder preparations and artificial alizarine and its allies are treated at great length. Madder from Monte Video is described as having made its appearance in the market, and is said to be of very good quality.

Nature of Chloride of Lime, and on its Spontaneous Decomposition.—M. O. Opl.—From this lengthy paper we extract for the present merely the author's practical conclusions. He maintains that for the production of a good chloride of lime the temperature of the chambers must be as low as possible, winter being always found the most favourable season for the manufacture. In hot chambers, strong chloride of lime cannot be produced, as it heats readily and is decomposed. At a temperature of production of 15° Reaumur, chloride of lime differs in consistence and appearance from such as is obtained at 25° . The former constitutes, in the chamber, a firm bed, which may be crushed into a fine, dry powder, whilst the latter is soft and damp, and gives off a strong odour of chlorine. To prepare a strong and stable chloride, chlorine should be used free from hydrochloric acid and carbonic acid, and should enter the chamber as cold as possible. The hydrate of lime should be very pure, and should be mixed with as much water as can be added without inconvenience in sifting. The chambers should be kept during the absorption at as low a temperature as possible, not exceeding 20° R., and should have a shape which admits of easy cleaning. After removing the chloride of lime from the chambers, it should be left in chests fitted with covers, and should be often turned over, so that its temperature may fall at any rate to 17° R. before it is packed up in casks.

Assay of Type Metal and of Alloys used as White Metal.—M. A. G. Pouchet.—This paper does not admit of useful abstraction.

Observations on the Analysis of Nitrogenous Matter used as Manure.—M. A. Bobierre.—The author points out that in the soda-lime process ammonia may be dissociated by the application of too high and prolonged a heat, and the amount of nitrogen may consequently be found too low.

New Method of Analysis by Means of Standard Liquids.—M. F. Jean.—Reserved for insertion in full.

Modification of the Liquids of Fehling and Barreswill, used for the Determination of Glucose.—M. P. Lagrange.—The author proposes the following formula:—

| | | | |
|--------------------------------|---------|-----|-------|
| Dry neutral tartrate of copper | .. | 10 | grms. |
| Pure caustic soda | .. .. . | 400 | „ |
| Distilled water | .. .. . | 500 | c.c. |

It is not affected by diffused light. The tartrate of copper is obtained by decomposing sulphate of copper with neutral tartrate of soda. The precipitate is washed by decantation and dried at 100°.

Method of Analysing Cheese.—Neubauer.—Not suitable for abstraction.

Assay of Cloth Dyed Turkey Red.—Armand Müller.—The author applies for this purpose the method proposed by V. Wartha for obtaining alizarin in a state of purity. Wartha treats the dyed goods in the water-bath with a mixture of alcohol and strong hydrochloric acid. To the extract he adds potash, and filters off the rich violet-purple precipitate produced, which he then washes and decomposes on the filter with dilute hydrochloric acid. The yellowish-orange mass thus obtained is washed, dried, and sublimed. The author, repeating Wartha's experiments, observed that when swatches of cloth were placed in the same extraction bath, the solution of the colouring matter required different lengths of time according as they had been dyed at different establishments. A more attentive study of this phenomenon led to a result no less interesting than unexpected—that the time necessary for decolouration does not vary with the quantity of alizarin, but is directly proportional to the resistance of the colours to light, carbonate of soda, soap, acids, and oxidising agents, and depends, therefore, on the nature of the mordant employed. Further experiments showed that Turkey red resisted longer or shorter as it contained more or less alumina; whilst dyed cloth, from which it was possible to remove a certain quantity of the known compound of fat and alizarin, were much less solid. The author does not hold that the use of oil makes the colour fugitive; but he concludes that oil cannot brighten the red until it has been brought to that still unknown state of oxidation in which it is no longer soluble in ether, and that a residue of unsaponified fat has an injurious action, especially as regards the influence of light. To execute the assays, the author takes equal weights of the goods to be tested, and plunges them in a bath of 10 vols. alcohol at 96 per cent. and 1 vol. hydrochloric acid at 1.18 spec. grav. The mixture, which should be used in large quantities, is slowly heated to about 50°. The exact time for the total discharge of the colour of each swatch is carefully noted.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 4, May 27, 1875.

Specific Inductive Power of Insulants.—F. Rosetti.—The author holds that this power depends on a state of electric polarity, which the molecules of the body assume during the induction. This state of polarity is produced by the induction current which precedes the electric induction itself, and is transmitted across the non-conductive mass by an *actio in distans* between adjacent molecules. The formula of Ohm includes also the laws of condensers, and may be employed with advantage to determine the

specific inductive power of insulators. In this manner the specific power of glass is found to be 3.45; of spermaceti, 2.18; of ebonite, 2.05; of sulphur, 1.81; that of air being taken as unity.

Internal Latent Heat.—M. Avenarius.—The author has repeated the experiments of Gagniard-Latour.

No. 5, June 3, 1875.

This issue contains no chemical matter.

No. 6, June 10, 1875.

Electric Illumination of Railways and Ships.—M. Emile Girouard.—The electric light has been successfully employed on the Moscow and Kursk line in Russia.

A Perfect Process for Bleaching all Colouring Matters.—As the details of this process are withheld it is impossible to judge of its "perfection."

Chemistry of the Soda Manufacture.—A notice of Stevenson and Williamson's process.

MISCELLANEOUS.

Royal United Service Institution.—A lecture was recently delivered at this Institution (7th ult.) "On the Methods of Ascertaining the Relative Value of Coals for Naval Purposes," by Edward Eckersley, chief engineer, R.N. The chair was occupied by Admiral Sir Henry Codrington, K.C.B. The Lecturer said that naval officers were sometimes placed in positions in which it would be beneficial if they could form a just estimate between different qualities of coal; he then described, and experimentally illustrated, a few of the methods in which scientific men deal with this subject, coupled with his own experience and observation. In the hands of ready manipulators the Admiralty, or other large purchasers of coal had, in Mr. Lewis Thompson's calorimeter, a ready and approximate means of testing the evaporative value of different kinds of coal. Combined with its aid, practical men would find the tests for water, ash, and the litharge test for carbon, to be sufficient. The water-oven, the improved calorimeter, and other necessary apparatus for the purpose could, and ought to be, fitted in our flagships. In the discussion which followed, and was taken part in by Admiral Codrington, Mr. Tuck, R.N., the Secretary, and others, an opinion was expressed, and received with marks of much approval by the meeting, that the Admiralty might be induced to take the matter up, first, with reference to the examinations of engineer-students on this subject, and that chief-engineers of the Royal Navy should be required by the Admiralty to make a more special study, at the Royal Naval College, Greenwich, and at the Royal Laboratory, Woolwich, of this important question of how to adopt the most efficient means of testing steam-coal when afloat, according to the most approved methods; and, secondly, in regard to supplying steamships with testing-apparatus.

NOTES AND QUERIES.

Value of Fuel.—Would any of your correspondents kindly tell me the method which is now adopted for determining the pyrometric value of fuel, and the absolute amount of heat evolved by various kinds of fuel? How is the mechanical equivalent calculated from the above data?—W. C. PARSONS.

Manufacture of Oils.—Can any reader inform me of the best publication on the manufacture of oils, &c.?—W. H. B.

Decolorisation of Blood Albumen.—(Reply to G. Jones.)—In reference to the decolorisation of blood albumen, a very cheap and simple method is to add, to a solution of blood albumen at 110° F., an eighth part of turpentine. By allowing this to stand two or three days, and stirring occasionally, a solution is obtained of a very good colour, and which, when dried on a glass plate, gives an albumen of a much lighter colour than the original.—WILLIAM BROWNING.

ERRATUM.—Page 275, line 39 from top, for "nitric" read "nitrous."

THE CHEMICAL NEWS.

VOL. XXXI. No. 816.

ON RELATIONS AMONG THE ATOMIC WEIGHTS OF THE ELEMENTS WHEN ARRANGED IN THEIR NATURAL ORDER.

By JOHN A. R. NEWLANDS, F.C.S.

It is a singular circumstance that handbooks of Chemistry which contain tables of various data, such as boiling-points, melting-points, specific gravities, latent heat, specific heat, conducting powers for heat and electricity, &c., in the natural order should, in reference to the atomic weights of the elements, give no similar table, but merely contain an alphabetical arrangement.

The principal object of the present paper is to call attention to this striking omission, which will doubtless be soon remedied by the introduction into treatises on Chemistry, of a table of the atomic weights of the elements in their natural order, in addition to the usual convenient alphabetical arrangement.

I now offer a Table of this description; the different columns of the table give as follows:—1st, the ordinal number; 2nd, the symbol; 3rd, the atomic weight; and 4th, the difference between each atomic weight and that preceding it. All the atomic weights except that of thallium, and also five marked as doubtful, viz., those of yttrium, didymium, cerium, erbium, and lanthanum, are taken from Fownes's "Chemistry," 11th edition, 1873.

TABLE I.—*Elements in Order of Atomic Weight.*

| No. | Symb. | At. Wt. | Diff. | No. | Symb. | At. Wt. | Diff. |
|-----|-------|---------|-------|-----|-------|---------|-------|
| 1 | H | 1 | — | 33 | Zr | 89.6 | 1.6 |
| 2 | Li | 7 | 6 | 34 | Nb | 94 | 4.4 |
| 3 | Be | 9.4 | 2.4 | 35 | Mo | 96 | 2 |
| 4 | B | 11 | 1.6 | 36 | Rh | 104.4 | 8.4 |
| 5 | C | 12 | 1 | 37 | Ru | 104.4 | 0 |
| 6 | N | 14 | 2 | 38 | Pd | 106.6 | 2.2 |
| 7 | O | 16 | 2 | 39 | Ag | 108 | 1.4 |
| 8 | F | 19 | 3 | 40 | Cd | 112 | 4 |
| 9 | Na | 23 | 4 | 41 | In | 113.4 | 1.4 |
| 10 | Mg | 24 | 1 | 42 | Sn | 118 | 4.6 |
| 11 | Al | 27.4 | 3.4 | 43 | Sb | 122 | 4 |
| 12 | Si | 28 | 0.6 | 44 | I | 127 | 5 |
| 13 | P | 31 | 3 | 45 | Te | 128 | 1 |
| 14 | S | 32 | 1 | 46 | Cs | 133 | 5 |
| 15 | Cl | 35.5 | 3.5 | 47 | Ba | 137 | 4 |
| 16 | K | 39.1 | 3.6 | 48 | Di | 138 (?) | 1 |
| 17 | Ca | 40 | 0.9 | 49 | Ce | 140 (?) | 2 |
| 18 | Ti | 50 | 10 | 50 | Er | 178 (?) | 38 |
| 19 | V | 51.2 | 1.2 | 51 | La | 180 (?) | 2 |
| 20 | Cr | 52.2 | 1 | 52 | Ta | 182 | 2 |
| 21 | Mn | 55 | 2.8 | 53 | W | 184 | 2 |
| 22 | Fe | 56 | 1 | 54 | Au | 197 | 13 |
| 23 | Ni | 58.8 | 2.8 | 55 | Pt | 197.4 | 0.4 |
| 24 | Co | 58.8 | 0 | 56 | Ir | 198 | 0.6 |
| 25 | Cu | 63.4 | 4.6 | 57 | Os | 199.2 | 1.2 |
| 26 | Zn | 65.2 | 1.8 | 58 | Hg | 200 | 0.8 |
| 27 | As | 75 | 9.8 | 59 | Tl | 203.6 | 3.6 |
| 28 | Se | 79.4 | 4.4 | 60 | Pb | 207 | 3.4 |
| 29 | Br | 80 | 0.6 | 61 | Bi | 210 | 3 |
| 30 | Rb | 85.4 | 5.4 | 62 | Th | 235 | 25 |
| 31 | Sr | 87.6 | 2.2 | 63 | U | 240 | 5 |
| 32 | Y | 88 (?) | 0.4 | | | | |

On carefully examining this table many interesting facts may be observed, and a few of these will now be briefly indicated. If we start with the fifth element we find that it and all the following elements up to and including No. 17, are elements of great importance from their being widely diffused in the earth, the ocean, or the atmosphere,

forming a large proportion of the earth's crust, and being essential to animal and vegetable life. Their very names recall the constituents most frequently mentioned in analyses of soils, waters, &c., as carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium, and calcium. If to these we add hydrogen and iron such a list will include all the most important elements. If we omit fluorine, which is perhaps not so important as the rest, the list will comprise two representatives of each of the seven principal groups of elements, thus:—

(See CHEMICAL NEWS, vol. xxvi, p. 19.)

Monads—Sodium and potassium.

Dyads—Magnesium and calcium.

Triads—Aluminium and iron.

Tetrads—Carbon and silicon.

Triads (or pentads)—Nitrogen and phosphorus.

Dyads (or hexads)—Oxygen and sulphur.

Monads (or heptads)—Hydrogen and chlorine.

Another remarkable circumstance to which I first called attention in the CHEMICAL NEWS, vol. x, p. 94 (August 20, 1864), is the fact of a simple relation existing between all the known elements when arranged in the natural order of their atomic weights. This fact may be perhaps most simply stated in the following manner:—"Elements belonging to the same group stand to each other in a relation similar to that between the extremes of one or more octaves in music." Thus, if we commence counting at lithium, calling it 1, sodium will be 8, and potassium 15, and so on. To save the trouble of counting in each individual case, and also to render the relationship obvious at a glance it is convenient to adopt a horizontal arrangement, as in Table II. (see next page).

In this table the unoccupied spaces may be filled up by elements at present undiscovered, or even by known elements whose atomic weights have not yet been accurately determined. Although the position occupied by certain of the elements is open to dispute, this table will yet be found to give a good general idea of the chief Chemical Groups, whilst preserving the natural order of the atomic weights.

The quantivalence of the elements on the different horizontal lines is usually as follows:—

| | | | |
|------|---|---|-----------------------|
| Line | a | — | Monads. |
| " | b | — | Dyads. |
| " | c | — | Triads. |
| " | d | — | Tetrads. |
| " | e | — | Triads, (or pentads.) |
| " | f | — | Dyads, (or hexads.) |
| " | g | — | Monads, (or heptads.) |

There are however several exceptions to this rule.

It frequently happens that the atomic weights of allied elements differ by about 16, or some other multiple of 8, as in the following cases:—

| | | | |
|---------------|--------|---|-----------------|
| Lithium, 7 | + 16 | = | Sodium, 23 |
| Sodium, 23 | + 16.1 | = | Potassium, 39.1 |
| Magnesium, 24 | + 16 | = | Calcium, 40 |
| Carbon, 12 | + 16 | = | Silicon, 28 |
| Oxygen, 16 | + 16 | = | Sulphur, 32 |

Other examples of the same fact may be found in papers by the author in the CHEMICAL NEWS, vol. vii., p. 70., Feb. 7, 1863, and vol. x., p. 59, July 30th, 1864.

If the atomic weights of the elements really followed the strictly natural order, they would coincide with their ordinal numbers, provided, of course, that the atomic weight chosen as the unit was the true unit, and not some multiple or fraction of the true unit.

Now, granting that the eighth element reckoning from a given one, such as potassium from sodium, is the next member of the same group, their atomic weights should, if following the natural order, differ by 7, just as their ordinal numbers differ by 7, whereas the actual difference is 16.1; so that the atomic weights are equal to the natural numbers multiplied by 2.3, for $7 \times 2.3 = 16.1$.

TABLE II.—Elements in Order of Atomic Weight.—Horizontal Arrangement.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|----|-----|--------|---------|---------|---------|---------|-----------|----------|----------|-------------|----|-------------|----------|----------|----|----------|
| a. | — | Li 7.0 | Na 23.0 | K 39.1 | — | Cu 63.4 | Rb 85.4 | — | Ag 108.0 | Cs 133.0 | — | — | Au 197.0 | — | — | — |
| b. | — | Be 9.4 | Mg 24.0 | Ca 40.0 | — | Zn 65.2 | Sr 87.6 | — | Cd 112.0 | Ba 137.0 | — | — | — | Hg 200.0 | — | — |
| c. | — | B 11.0 | Al 27.4 | — | Fe 56.0 | — | Y 88.0(?) | — | In 113.4 | Di 138.0(?) | — | Er 178.0(?) | — | Tl 203.6 | — | — |
| d. | — | C 12.0 | Si 28.0 | Ti 50.0 | — | — | Zr 89.6 | Rh 104.4 | Sn 118.0 | Ce 140.0(?) | — | La 180.0(?) | Pt 197.4 | Pb 207.0 | — | Th 235.0 |
| e. | — | N 14.0 | P 31.0 | V 51.2 | — | As 75.0 | Nb 94.0 | Ru 104.4 | Sb 122.0 | — | — | Ta 182.0 | Ir 198.0 | Bi 210.0 | — | — |
| f. | — | O 16.0 | S 32.0 | Cr 52.2 | Ni 58.8 | Se 79.4 | Mo 96.0 | Pd 106.6 | Te 128.0 | — | — | W 184.0 | Os 199.2 | — | — | U 240.0 |
| g. | H 1 | F 19.0 | Cl 35.5 | Mn 55.0 | Co 58.8 | Br 80.0 | — | — | I 127.0 | — | — | — | — | — | — | — |

If, therefore, we divide all the atomic weights by 2.3, or, what amounts to the same thing, if we make a table of the atomic weights taking that of sodium as 10, the atomic weights so obtained will be found to approach pretty closely to the natural order, especially when we compare the differences between elements in such parts of the list as are probably more complete than the others.

In Table III. such a list is given, and although no one would wish to abandon for most purposes the ordinary atomic weights founded upon hydrogen as unity, still it is both interesting and instructive to regard such familiar data from a new point of view.

TABLE III.—Elements in Order of Atomic Weight, taking the Atomic Weight of Sodium as 10.

| No. | Symb. | At. Wt. | No. | Symb. | At. Wt. |
|-----|-------|-----------|-----|-------|-----------|
| 1 | H | 0.435 | 33 | Zr | 38.96 |
| 2 | Li | 3.04 | 34 | Nb | 40.87 |
| 3 | Be | 4.09 | 35 | Mo | 41.74 |
| 4 | B | 4.80 | 36 | Rh | 45.39 |
| 5 | C | 5.22 | 37 | Ru | 45.39 |
| 6 | N | 6.09 | 38 | Pd | 46.35 |
| 7 | O | 6.96 | 39 | Ag | 46.96 |
| 8 | F | 8.26 | 40 | Cd | 48.70 |
| 9 | Na | 10.00 | 41 | In | 49.30 |
| 10 | Mg | 10.43 | 42 | Sn | 51.30 |
| 11 | Al | 11.91 | 43 | Sb | 53.04 |
| 12 | Si | 12.20 | 44 | I | 55.22 |
| 13 | P | 13.48 | 45 | Te | 55.65 |
| 14 | S | 13.91 | 46 | Cs | 57.83 |
| 15 | Cl | 15.43 | 47 | Ba | 59.57 |
| 16 | K | 17.00 | 48 | Di | 60.00 (?) |
| 17 | Ca | 17.39 | 49 | Ce | 60.87 (?) |
| 18 | Ti | 21.74 | 50 | Er | 77.39 (?) |
| 19 | V | 22.26 | 51 | La | 78.26 (?) |
| 20 | Cr | 22.70 | 52 | Ta | 79.13 |
| 21 | Mn | 23.91 | 53 | W | 80.00 |
| 22 | Fe | 24.35 | 54 | Au | 85.65 |
| 23 | Ni | 25.57 | 55 | Pt | 85.83 |
| 24 | Co | 25.57 | 56 | Ir | 86.09 |
| 25 | Cu | 27.57 | 57 | Os | 86.61 |
| 26 | Zn | 28.35 | 58 | Hg | 86.96 |
| 27 | As | 32.61 | 59 | Tl | 88.52 |
| 28 | Se | 34.52 | 60 | Pb | 90.00 |
| 29 | Br | 34.78 | 61 | Bi | 91.30 |
| 30 | Rb | 37.13 | 62 | Th | 102.17 |
| 31 | Sr | 38.09 | 63 | U | 104.35 |
| 32 | Y | 38.26 (?) | | | |

In conclusion, I have only to add a few remarks, which are unfortunately rendered necessary by the way in which some writers persistently ignore all mention of the names of their co-labourers in science, whether in connection with theoretical or practical questions.

The grand point I have contended for, and do contend for, is the existence of a simple relation among the elements when arranged in the order of their atomic weights. This fact was published by me in the CHEMICAL NEWS for August 20th, 1864, vol. x., p. 94. I again called attention to it in the CHEMICAL NEWS for August 18th and 25th, 1865, vol. xii., pp. 83 and 94.

On March 1st, 1866, I read a paper on the subject before the Chemical Society; and at that time the mere notion of anyone even seeking to find a simple relation among the elements when arranged in their natural order was looked upon as so absurd that one of the most distinguished members of the Society asked me "if I had

ever examined the elements according to the order of their initial letters." (See CHEMICAL NEWS, vol. xiii., p. 113).

My paper was returned to me as "not adapted for publication in the Society's Journal." Seven years later, in the *Journal of the Chemical Society* for June, 1873, appeared a paper by M. L. Meyer, in which reference is made to M. Mendeljeff as having shown that certain properties of the elements appear "as a regular periodical function of the atomic weight, if the elements are arranged in the natural system, or according to the numerical values of their atomic weights." I at once wrote a letter to the Secretary of the Chemical Society, claiming priority in this matter, giving the dates of my various papers on the subject, and in conclusion asking "as a simple matter of justice, the insertion of this brief note in the Society's Journal." This note was read before the Society on June 19th, 1873, and the President (Dr. Odling) then said "that the reason why my paper on this subject in 1866 had not been published by the Society was that they had made it a rule not to publish papers of a purely theoretical nature, since it was likely to lead to correspondence of a controversial character."

On my remarking that M. L. Meyer's paper was of a purely theoretical character, I was told that "it was not inserted in the body of the Society's Journal, but only in the Abstracts from other journals; and that, at any rate, I had the CHEMICAL NEWS "to refer to as to what I had written upon the subject." It remains to be said that though the title of my note was printed, the note itself was not inserted either in the body of the Society's Journal or in the Abstracts from other Journals.

London, June 18, 1875.

CALCIC HYPOCHLORITE FROM BLEACHING-POWDER.*

By CHARLES T. KINGZETT, F.C.S., &c.

IN bringing before the Chemical Society the following observations, in their present very imperfect condition, I feel justified by only one consideration, viz., that of my inability to pursue these experiments for some time to come. I therefore hope that the interest and importance that is attached to them will prove sufficient to atone for their incompleteness.

The older view of bleaching-powder, and that shared by Berthollet, was that it is a direct union of chlorine with the base, $\text{CaO} \cdot \text{Cl}_2$.

Miller and Muspratt regarded it as a peroxide in which oxygen was replaced by chlorine, $\text{Ca} \left\{ \begin{smallmatrix} \text{O} \\ \text{Cl}_2 \end{smallmatrix} \right.$.

Fresenius regards it as a mixture of hypochlorite and basic chloride of calcium, $\text{CaCl}_2\text{O}_2 + \text{CaCl}_2 \cdot 2\text{CaO} + 4\text{H}_2\text{O}$ (see Richardson and Watts's "Technology," vol. i., p. 400).

Gay-Lussac considered it to consist of a mixture of chloride and hypochlorite of calcium, $\text{CaCl}_2\text{O}_2 + \text{CaCl}_2$, and, leaving out of consideration the excess of lime, this is still the popular view.

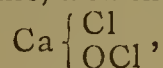
Crace-Calvert described experiments in 1872 (*Compt. Rend.*, May 27th, 1872) which led him to regard bleaching-powder as a mixture of one part hypochlorite to two parts of chloride of calcium, $\text{CaCl}_2\text{O}_2 + 2\text{CaCl}_2$, but, as

* From the *Journal of the Chemical Society*, May, 1875. With additional notes.

Kolb has shown the methods employed in these experiments to be faulty, the conclusions may be dismissed.

Moreover, recently, Goepner (*Dingler's Polytech. Journ.*, 209, 204) published a paper in which he states bleaching-powder to be a simple combination of lime and chlorine. This paper has been criticised by Schorlemmer in a note read before the Manchester Literary and Philosophical Society. We are thus reduced to Gay-Lussac's view of this body; but notwithstanding this, the question whether the chloride and hypochlorite of calcium exist in chemical combination or only in the state of mixture, is one still left for solution.

Odling looks upon this body as a hypochlorite and chloride at the same time, and thus represents it—



and this view is supported both by theoretical considerations and by experiments. The theoretical consideration I allude to is that which regards calcium as a dyad; and the experiments are those which show that alcohol does not extract chloride of calcium from bleaching-powder, whereas by treating it with water, the excess of chloride of calcium is first removed, and after that chloride and hypochlorite are extracted together in the proportions required by the above formula.

If it be granted that I have obtained hypochlorite of calcium from a solution of bleaching-powder in the manner presently shown, then we must conclude either that water breaks up this double combination, if such it be, into the free bodies, or else that bleaching-powder itself is but a mixture of them (a conclusion not supported by other considerations). *Therefore, bleaching-powder in such a case, has the formula assigned to it by Odling, but the combination is so feeble that water destroys it.* As regards hypochlorite of calcium, so far as I can learn, it seems to be known only in a state of mixture with chloride of calcium.

There is, however, a statement in Gmelin's "Handbook," vol. ii., p. 300, that Marchand found pure hypochlorite to be formed when a mixed stream of chlorine and oxygen was passed through calcic hydrate (*Journ. pr. Chem.*, xvi., 48). But even this statement is called in question, and is very doubtful, whilst it seems to be a fact, that *hypochlorite has never before been obtained in the solid state.*

I was induced to make the following experiments by an observation which I made four years ago, when needle-shaped crystals were formed in a saturated solution of bleaching-powder, which had been exposed during a frosty night. Twelve months ago I repeated this experiment in the following manner:—

Experiment 1.—One pound of bleaching-powder was exhausted with water, and the solution after being filtered was left to itself for three weeks; but no crystals were thus obtained. The solution in a bottle was now exposed to a freezing mixture of ice and salt, when the whole froze to a solid mass, which was broken up by agitation and thrown upon a filter. The mass gradually thawed, leaving on the filter feather-like crystals, some of which were nearly an inch long. They were freed from mother-liquor by pressure between folds of blotting-paper, and weighed 0.9 gm.

On replacing them in water, carbonate of calcium remained undissolved.

The solution evolved chlorine with acids, and contained calcium. Moreover, the pressure-dried crystals evolved a powerful odour of hypochlorous acid.

Experiment 2—was made after an interval of six months on a different specimen of bleaching-powder. Moreover all the remaining experiments were made with the same solution as that which furnished the present experiment.

Two pounds of powder were thoroughly digested in the cold with a litre of water, and after standing and shaking for six or seven days, the solution was filtered and bottled.

100 c.c. were now exposed to a freezing mixture for two hours, but the cold was not sufficiently intense to freeze the solution, and no crystals were thus obtained. The solution was now evaporated in a vacuum over sulphuric acid and potash. After forty hours a dense crystallisation formed on the bottom of the dish. The mass was, therefore, filtered and rinsed once or twice with small quantities of water, then somewhat pressed between folds of paper and dissolved in water. The solution had the following properties.

On exposure to the air a deposit of calcic carbonate occurred, and the solution emitted a suffocating odour of hypochlorous acid. It contained chlorine and calcium, and evolved free chlorine with strong hydrochloric acid. It rapidly peroxidised MnO to MnO₂, and had a very powerful bleaching action.

The total weight of crystals obtained as described was 4 to 5 grms., and they were insoluble in alcohol: chlorate is readily soluble.

Experiment 3.—At first I thought freezing was necessary for the production of these crystals, but it was subsequently found that simple evaporation in a vacuum was sufficient.

Another portion (200 c.c.) of bleaching-powder solution was taken and evaporated in a vacuum over sulphuric acid and caustic potash. After eight days, a rapid crystallisation occurred; the crystals were removed, and the clear mother-liquor further evaporated, when a second large crop of crystals was obtained.

Examination and Analysis of First Crop of Crystals.

They were rapidly washed on a small filter with small but repeated quantities of water, whereby more than two-thirds were re-dissolved. The washing has to be effected rapidly, as the substance quickly destroys the paper.

The crystals were now fairly dried by pressure between folds of paper, and found to weigh nearly 2 grms.

Here I may remark that from the time the crystals are removed from the solutions, all operations must be conducted with the utmost celerity, as decomposition immediately occurs, with loss of either chlorine or hypochlorous acid, &c.

0.7820 gm. of the body was weighed out in a platinum crucible, and caustic soda (made from pure metal) poured over it; a little saltpetre soda mixture (to increase the bulk) was now added, a thorough mixture effected, the whole evaporated to dryness, and *fused well*. The melted mass was dissolved in nitric acid, and the calcium estimated in solution by the oxalate method, and the chlorine in the filtrate as ordinarily. This gave 0.203 gm. CaO = to 18.542 per cent Ca, and 0.9548 gm. AgCl = to 30.205 per cent Cl.

Now if Ca stood to Cl as Ca : Cl₂, then 18.542 Ca requires 32.91 Cl. It is therefore evident that notwithstanding the haste made with the determinations, a decomposition had occurred equal to the loss of 2.7 per cent chlorine.

0.3150 gm. of the substance heated to 100° C. till the weight was constant, weighed 0.1912 gm. It had therefore lost 60.7 per cent by weight, while the residue contained much carbonate of calcium, and gave on treatment with nitric acid an evolution of a chlorinated body, so that the chlorine could not be estimated in it.

Now hypochlorite of composition CaCl₂O₂.4H₂O would give 18.604 per cent Ca as against 18.54 found

33.02 " Cl " 30.20 "
and supposing all the water and all chlorine to be evolved at 100° C. in the air-bath, 66.51 per cent loss as against 60.70 found, and, as shown above, all the chlorine was not expelled, doubtless from formation of a little chlorate.

Examination and Analysis of Second Crop of Crystals.

These crystals were washed and dried as the first crop, the total weight being about 10 or 12 grms. These operations were effected most rapidly, and the substance

replaced in the vacuum over sulphuric acid. During this drying, it lost much chlorine, which could be smelt in the receiver; thus when it had been under the air-pump for several days, and must have been practically dry, it lost in 20 hours 0.35 grm. by weight.

After four days it was rapidly powdered and subjected to the following examination. All weighings were effected at the same time:—

A little was dissolved in water (mere opalescence) and carbonic anhydride was passed through the solution, when a chlorinated body was evolved, and a vast precipitate of CaCO_3 formed. When this was done hot, chlorate was undoubtedly formed in the solution as indicated by the ordinary tests for chlorates. All the chlorine could not be expelled by carbonic anhydride in the cold. This reaction is characteristic of hypochlorites.

Calcium and chlorine were determined by solution in water, and destruction of hypochlorite by ammonia (Kolbe's method) in the hot solution. Then calcium was precipitated as oxalate (and determined as CaO), whilst chlorine was estimated in the filtrate.

Water was estimated by heating in a platinum boat, contained in a tube filled with lead chromate, and fitted with a sulphuric acid tube as in an organic analysis. This afforded an easy and effective method, not a trace of chlorine in any form passing over into the sulphuric acid tube.

0.503 grm. gave 0.1778 grm. CaO = 25.24 per cent Ca , and 0.7412 grm. AgCl = to 36.45 per cent Cl .

0.3986 grm. gave 0.0724 grm. water = 18.16 per cent H_2O .

Thus we get—

| | Per cent. | ÷ at wgt. | ÷ $\text{Ca} = 1$. |
|----------------------|-----------|-----------|---------------------|
| Ca | = 25.24 | 0.631 | 1.00 |
| Cl | = 36.45 | 1.026 | 1.62 |
| O | = 20.05 | 1.253 | 1.98 |
| H_2O | = 18.16 | 1.008 | 1.59 |

This may be regarded as a molecule of calcic hypochlorite in which nearly 0.5 atom of chlorine has been lost, for from beginning to end of the experiment oxygen (as air) was carefully excluded, and here the relation of calcium to oxygen is that which exists in hypochlorite.

Four days after this analysis had been made, the active chlorine was determined by Bunsen's method: 0.4454 grm. was dissolved in 200 c.c. water.

- a. 20 c.c. diluted to 100 c.c., KI and HCl added, &c., took 8.6 c.c. $\text{Na}_2\text{S}_2\text{O}_3$
- b. 20 c.c. diluted to 100 c.c., KI and HCl added, &c., took 8.7 " "
- Mean = 8.65 " "

1 c.c. $\text{Na}_2\text{S}_2\text{O}_3$ = 0.01224 iodine, therefore by reaction $\text{CaCl}_2\text{O}_2 + 4\text{HCl} = 2\text{H}_2\text{O} + \text{CaCl}_2 + 2\text{Cl}_2$ = to 33.21 per cent Cl .

The difference between 36.45 per cent Cl in previous analysis by this ammonia method, and 33.21 per cent Cl by Bunsen's method, I am inclined to regard as loss during the interval above alluded to, rather than as a proof of the presence of any chloride. But even if this difference proved chloride to be present and indicated an equivalent amount of chlorate, that must have arisen from an internal decomposition under the air-pump, and then the bulk of the body must be regarded as hypochlorite.

Experiment 4.—This was an analysis of a distinct crop of freshly prepared crystals, which were not dried to the same extent as those in the foregoing analyses, although equally well washed. Calcium was determined by the fusion process (as CaSO_4), and so also the total chlorine, which was confirmed by ammonia method, whilst the active chlorine was estimated by Bunsen's method. Water was estimated as described above.

1.732 grm. gave 0.958 grm. CaSO_4 = 16.26 per cent Ca , and 1.693 AgCl = 24.17 per cent Cl .

In Bunsen's method, 1.133 grm. dissolved in 200 c.c. H_2O , 20 c.c. took in two experiments 15 c.c. $\text{Na}_2\text{S}_2\text{O}_3$ (1 c.c. $\text{Na}_2\text{S}_2\text{O}_3$ = 0.01224 I) = to 22.64 per cent Cl .

0.7666 grm. gave 0.3624 grm. water = to 47.27 per cent H_2O .

Now deducting 47.27 per cent water, and re-calculating per cents for the free body, we get—

| | Per cent. | ÷ at wgt. | ÷ $\text{Ca} = 1$. |
|-------------|-----------|-----------|---------------------|
| Ca | = 30.83 | 0.77 | 1.0 |
| Cl | = 45.86 | 1.29 | 1.7 |
| O | = 23.31 | 1.45 | 2.0 |
| | 100.00 | | |

Or we may calculate the chlorine as given by Bunsen's method to exist as CaCl_2O_2 , and the excess of calcium to exist as CaO and CaCl_2 . Thus—

| | | |
|---------------------------|-------------------|---------------------------|
| CaCl_2O_2 | = 45.59 per cent. | |
| Water | = 47.27 " | |
| CaCl_2 | = 2.37 " | |
| CaO | = 3.71 " | or CaCO_3 = 6.62 |
| | 98.94 " | 101.85 per cent. |

Calculate it as we may, it evidently nearly pure hypochlorite, and this is confirmed by its properties, and above all things by the determination of chlorine by Kolbe's ammonia process, which would give only Cl as CaCl_2O_2 and CaCl_2 . This determination was not effected till the next day, when 0.306 grm. gave 0.320 grm. AgCl = to 25.86 per cent, a result identical with the total chlorine in the previous analysis, or at least only in such slight excess as would be caused by the substance having become slightly drier during the interval between the respective analyses.

This body is so prone to decompose in certain phases of its existence, that it might be expected to be admixed with chlorate at times, and this indeed seemed to be the case in one analysis, where it had reference to a product which had been dried under circumstances which involved hammering, but moreover it was the *crust* from the solution which on further evaporation yielded crystals whose analysis has been last given.

Ca and Cl determined only by the ammonia process, and water as already described, gave—

| | ÷ at wgt. | ÷ $\text{Ca} = 1$. | |
|----------------------|-----------|---------------------|------|
| Ca | = 20.45 | 0.511 | 1.00 |
| Cl | = 29.19 | 0.822 | 1.60 |
| O | = 23.59 | 1.469 | 2.87 |
| H_2O | = 26.77 | 1.480 | 2.89 |
| | 100.00 | | |

} $\times 5$ { $\text{Ca}_5\text{Cl}_{10}\text{O}_{14}$
4 CaCl_2O_2
+ CaCl_2O_6
 $\text{Ca}_5\text{Cl}_{10}\text{O}_{14}$

Unfortunately in this analysis the total and active chlorine were not respectively estimated.

Finally, I may add that although the foregoing may be regarded as perfect proof of the body being in mass, hypochlorite of calcium (and to my mind this conclusion is inevitable), yet nevertheless, one cannot be too careful in concluding on evidence which is at all doubtful. I therefore consider that it is highly desirable that these experiments should be repeated on many samples of bleaching-powder, special care being devoted to the determination of the form in which the chlorine is attached. I can only regret that I am unable to undertake this work, at the present time.

ADDITIONAL NOTES.

In the first place I wish to point out that in what has gone before, the identity of those crystals obtained by freezing a strong solution of bleaching-powder, with those obtained by evaporation over sulphuric acid *in vacuo*, has not been established by analysis.

But I especially wish to direct attention here, to the possible application of the knowledge obtained through the experiments described, to industry.

The use of bleaching-powder was patented in 1799 by Mr. Tennant, and it soon superseded the use of "Lye of Javelle," and also of *solution* of chloride of lime.

The advantages "bleaching-powder" possesses over its solution, are obvious, and it is needless to specify them, but if pure hypochlorite of calcium could be made commercially, it would supersede the manufacture of bleaching-powder, seeing that (a) it is entirely and easily soluble in water, and (b) it possesses the total bleaching effect of "bleaching-powder" in much less volume.

And here I must state that what follows I wish to be regarded rather as suggestions than propositions.

The "bleach liquor" could be prepared from dilute chlorine, that is, from such chlorine as is manufactured by Deacon's process, or (in part) by Weldon's "manganite of magnesium" process. This would be effected in the way suggested by Mr. Weldon, which is carried out by introducing the gas into towers lined with lead, where it meets a shower of "milk of lime," and reacts

on it to form "bleach liquor" $\text{CaCl}_2\text{O}_2 + \text{CaCl}_2$. Care would have to be taken not to employ an excess of chlorine, as is done by Mr. Weldon, for if this were done, hypochlorous acid and chloride of calcium only would result. But the absorption of chlorine would be limited to the production of "bleach liquor." Now comes the great difficulty, viz., how to concentrate that liquor so as to crystallise out, or otherwise separate, the hypochlorite of calcium it contains.

Heat cannot be employed, as it causes the decomposition of the hypochlorite.

It was thought that freezing might perhaps be resorted to, but beyond the difficulty that would attend such an operation on a large scale, the few experiments I made in that direction went to show that the hypochlorite froze with the ice, that is it solidified in combination with the water. If in any way it could be concentrated over lime, that lime could be used for making the "milk of lime" in a new operation, and so no chlorine would be lost.

But how this is possible, or whether a vacuum pan of any specific construction could be employed, are questions which I cannot answer, although they are questions well worthy of consideration, by men who are used to encountering such difficulties.

ON MELLILOTOL.

By Dr. T. L. PHIPSON.

MELLILOTOL is an acid oil slightly soluble in water, soluble in alcohol and ether, transformed into mellilotic acid (of Zwenger) by the action of potassa and in other circumstances. It is endowed with a most fragrant odour, which is that of new mown hay. I have obtained it by distilling *Mellilotus officinalis* with water and isolating it from the distillate by means of ether. The plant was gathered while in full bloom; that which grows in sheltered places on our southern coasts, and is in flower in August is rather rich in this product. About 0.2 per cent of pure mellilotol was obtained from the dried plant by distilling the stalks, leaves, and flowers together.

Mellilotol is the starting-point of a great variety of very interesting compounds; it yields, as before stated, mellilotic acid, which in its turn yields coumarin. *Mellilotol, and not coumarin, is the cause of the odour of the hayfields, and of the flowers of the mellilotus.* It is difficult to separate it entirely from mellilotic acid in the preparation of the latter; by boiling with concentrated potash it is transformed into mellilotic acid, whilst a slight odour of oil of bitter almonds is developed. The composition of mellilotol appears to be $\text{C}_{18}\text{H}_{18}\text{O}_4$, that of coumarin being $\text{C}_{18}\text{H}_{16}\text{O}_4$. It was in endeavouring to ascertain how much coumarin could be obtained from *mellilotus* growing at Weymouth, and extremely fragrant,

that I discovered this mellilotol, and I suppose it to be the oil which accompanied the mellilotic acid obtained by Zwenger.

London, July 11, 1875.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 11).

SINCE 1867 Tessié du Motay has attempted to apply the oxygen light to streets and squares. The places before the Tuileries and before the Hôtel de Ville were radiant with the light thrown off by cylinders of zircon† under the joint influence of coal-gas and oxygen. The fluctuating nature of the flame and the great expense induced him to turn his attention to the carburation of hydrogen and coal-gas. These gases were led before entering the burners into a vessel attached to each lamp, and containing heavy hydrocarbons. In this manner the Boulevards between Rue Drouot and Rue Scribe were illuminated with 70 oxygen burners. This method, also, was given up, and a highly carburetted gas was prepared in place of common coal-gas, and was burnt along with oxygen. In this new modification the process was seen by visitors to the Vienna Exhibition at the Empress Elizabeth Western Railway Terminus. From a manuscript report which Herr Karl Haase, manager of the 4th Berlin gas-works, handed in to the directors of the municipal committee on lighting, we borrow the following graphic description.

"The sight of the plantations of the Elizabeth Station, and of its various compartments lit up with coal-gas and oxygen, is quite surprising. The effect of the light given off by the small bluish flames of the lamps is quite peculiar, and cannot be paralleled by any other system of lighting. The green of the trees and shrubs appears more lively, the colour of costumes more brilliant; and above all the faces of persons seem more distinct. Every shade of colour and every configuration comes out almost as distinctly as in full day-light, and yet the eye is not wearied. This favourable impression received in the plantations is still heightened on entering the large second class waiting room. Here every object, and even the most trifling details of the decorations, are shown most distinctly by the small flames of two moderate-sized gaseliers.

"The strongest impression as regards the efficacy of this new system of illumination is experienced on entering the departure-platform. Here, in order to make the difference more striking, the stairs used by the departing passengers were lit up with heavy gas aided by oxygen, but only half as many lamps were kindled as on the opposite stairs, where the old gas was burning along with oxygen. In spite of the double number of the burners and the good quality of the coal-gas (equal 24 candles) the space lighted on the new system appeared far more brilliant."

In spite of this favourable impression, however, Haase declares the new double gas, which is conveyed in two sets of pipes, unsuitable for general private consumption. He gives, amongst others, the following reasons for his opinion. The advantage of brightness is more than compensated by the price, which in Berlin, calculated for the same degree of brightness would amount to double the price of common gas.

The consumer will not be able to manage accurately

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Burnt zirconia kneaded into a paste with aqueous boracic acid, and burnt in iron moulds at a red heat.

the changing regulation of the cocks. The oxygen will become impoverished by passing through long distances of mains, and the repairs of the double system will be considerable, &c. For certain public establishments, for millinery warehouses, and certain other purposes the new process will be well adapted. But it would be out of the question to keep up a triple system of mains for the sake of such limited applications. This opinion is in flat contradiction to that of Schiele;* but it agrees closely with the report which le Blanc† a year earlier had presented to the municipal gas direction of Paris.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

IN another column we publish a letter from Dr. Dupré on the subject of Milk Adulteration. We also reprint a report of certain proceedings in the Greenwich Police Court, and an extract from the parliamentary proceedings, reported in the *Times* of the 14th inst.

The subject is so important that we reprint the analyses of Dr. Voelcker referred to in Dr. Dupré's letter.

In 1863 Dr. Voelcker published a pamphlet on Milk, in which he gives the following table as the results of twenty-two analyses. The last column is added by us. It is, of course, simply the result obtained by adding together the casein, sugar, and ash:—

COMPOSITION OF MORNING'S AND EVENING'S MILK
PRODUCED ON THE ROYAL AGRICULTURAL
COLLEGE FARM, CIRENCESTER.

| | | Percentage of | | | | | |
|--------|-----------|---------------|---------------------|---------------------------|----------------|------|--------------------|
| | | Water. | Butter Pure Fat. | Casein and Albumen. | Milk Sugar. | Ash. | Solids not Fat. |
| Jan., | Morning.. | 87.70 | 2.60 | 2.94 | 5.82 | 0.94 | 9.70 |
| " | Evening.. | 87.40 | 2.28 | 2.87 | 6.56 | 0.89 | 10.34 |
| Feb., | Morning.. | 87.50 | 2.58 | 3.44 | 5.44 | 1.04 | 9.92 |
| " | Evening.. | 86.40 | 3.53 | 3.37 | 5.56 | 1.14 | 10.07 |
| March, | Morning | 88.60 | 2.71 | 2.43 | 5.35 | 0.91 | 8.69 |
| " | Evening.. | 88.16 | 2.96 | 2.62 | 5.55 | 0.77 | 8.88 |
| April, | Morning.. | 87.50 | 3.15 | 2.94 | 5.60 | 0.81 | 9.35 |
| " | Evening.. | 89.00 | 2.47 | 2.69 | 5.08 | 0.76 | 8.53 |
| May, | Morning.. | 88.20 | 2.42 | 3.12 | 5.49 | 0.77 | 9.38 |
| " | Evening.. | 87.80 | 2.71 | 2.87 | 5.85 | 0.77 | 9.49 |
| June, | Morning.. | 87.30 | 3.05 | 3.00 | 5.89 | 0.76 | 9.65 |
| " | Evening.. | 87.30 | 2.94 | 2.87 | 6.05 | 0.84 | 9.76 |
| July, | Morning.. | 88.70 | 2.22 | 2.94 | 5.38 | 0.76 | 9.98 |
| " | Evening.. | 87.80 | 3.61 | 2.81 | 5.10 | 0.68 | 8.56 |
| Sept., | Morning.. | 89.91 | 1.99 | 2.94 | 4.48 | 0.64 | 8.10 |
| " | Evening.. | 90.70 | 1.79 | 2.81 | 4.04 | 0.66 | 7.51 |
| Oct., | Morning.. | 87.60 | 3.90 | 2.87 | 4.84 | 0.79 | 8.50 |
| " | Evening.. | 90.30 | 2.99 | 2.37 | 3.76 | 0.58 | 6.71 |
| Nov., | Morning.. | 87.10 | 3.41 | 2.94 | 5.41 | 1.14 | 9.49 |
| " | Evening.. | 86.20 | 3.78 | 3.19 | 5.68 | 1.15 | 10.02 |
| Dec., | Morning.. | 86.70 | 3.74 | 2.87 | 5.92 | 0.77 | 9.56 |
| " | Evening.. | 86.00 | 4.12 | 3.62 | 5.46 | 0.80 | 9.88 |

The average of the whole of solids not fat is 9.18 per cent. Dr. Voelcker remarks in reference to these analyses, the milk cows were out in grass from May till the end of October, but as the herbage then became so scarce as not to afford sufficient nourishment, they were fed in the evening, in the stalls, with roots and hay, &c. It will be seen that both the morning's and evening's milk in September was extremely poor. The cows were then out in grass, but the pasture was poor and overstocked, so that the daily growth of grass furnished hardly enough food to meet the daily waste to which the animal frame is sub-

ject, and was thus not calculated to meet an extra demand of materials for the formation of curd and butter.

The poverty of this milk thus was evidently due to an insufficient supply of food.

In the same pamphlet he gives the results of the analyses of four samples of milk from two other farms on which the cows were out in grass, having an abundant supply of grass of good average quality; the solids not fat of which were 9.49, 9.04, 9.40, 8.71.

In subsequent pages in his pamphlet Dr. Voelcker gives 14 other analyses in which the solids not fat are as follows:—9.17, 9.84, 9.49, 9.04, 9.40, 8.71, 9.36, 8.94, 8.62, 9.22, 9.14, 9.31, 9.49, 9.29, the average of the whole being 9.21 per cent.

Last year Dr. Voelcker gave a lecture before the Farmer's Club, in which he repeated the table of figures given in 1863, apparently without any additional facts.

In most of these cases we are left to assume that the milk was perfectly genuine. It seems obvious, however, that in order to assume this fairly the cows should have been milked dry in the presence of the analyst himself or of equally trustworthy witnesses.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR.—It seems to me high time that our London magistrates should awake to the magnitude of the evil involved in milk adulteration. The fines usually inflicted are ludicrously inadequate to suppress the evil; and it is sufficient to make one's blood boil with indignation to see, in the same paper, a report of a poor, and presumably respectable and virtuous, girl being sentenced to fourteen days' imprisonment and four years in a reformatory for plucking a flower, and a number of milk adulterators fined from 2s. 6d. to 5s. for having added, say, from 15 to 20 per cent of water to their milk, to say nothing of those let off because, forsooth, they had added *only* 10 per cent. Now, a fine of 5s. simply means the sale of 12 quarts of water, which would be contained in 72 quarts, or 9 gallons, of milk and water, supposing 20 per cent of water to be added to the pure milk.

There are wholesale milk dealers in London to whom an addition of *only* 10 per cent of water to the milk they sell would yield a yearly profit of *only* from £1000 to £2000. And such an evil it is attempted to check by 2s. 6d. and 5s. fines!

I do not know the amount of milk consumed in London, but the daily consumption cannot be less, and is probably more, than 200,000 quarts. An addition of *only* 10 per cent means, therefore, something like 20,000 quarts of water sold daily as milk, which, at 5d. per quart, gives *only* £417 per diem, or a yearly trifle of *only* £152,000, no small proportion of the total London water-rate.

I trust, therefore, that in the interest of the public, but particularly in that of the poorer classes and of children, a thorough discussion of the milk question may take place in your columns so as to bring the magnitude of the evil still to be contended against home to all, including magistrates.

I am happy to be able to say that the quality of the milk supplied in my district has very greatly improved since the passing of the Adulteration Act, but I have no doubt that the improvement would have been greater still if the fines inflicted had been heavier.

A discussion such as I suggest would also, I think, finally dispose of Professor Voelcker's milk analyses, made avowedly on starving cows, at a time when milk analysis was certainly much less understood than it is now, and by means of methods of which we know nothing. As his pamphlet has already done much harm, and will, no doubt, do much more, I would call upon Professor Voelcker to publish the exact methods by means of which his results have been obtained.—I am, &c.,

A. DUPRÉ.

Westminster Hospital,
July 10, 1875.

* Schiele, *Journal f. Gasbeleuchtung*, Jan., 1873.

† "Rapport de M. F. le Blanc sur le nouvel éclairage oxyhydrique. Paris, 1872; also *Journal f. Gasbeleuchtung*, 1872, 641.

ADULTERATED MILK.

IN the House of Commons on July 13, "Dr. Cameron asked the Home Secretary whether his attention had been called to a report in the *Times* of July 3, from which it appeared that Mr. Balguy, the presiding magistrate at Greenwich Police Court, had publicly announced that, after consultation with his brother magistrates, he had resolved not to impose fines in cases of the adulteration of milk with water when such adulteration was not over 10 per cent, and whether the adulteration acts now in force warrant magistrates in allowing the adulteration of milk with water, if not practised to a greater extent than 10 per cent, to pass unpunished?"

"Mr. CROSS—Yes, it is substantially true that the magistrate did say so after having consulted with some of his brother magistrates; but I cannot think that is a view of the law which will be acquiesced in by my right hon. friend the President of Local Government Board, either under the act now in force, or under the bill now passing through the House."—*Times*, July 14, 1875.

Two summonses against persons for selling milk adulterated with 10 per cent of water came before Mr. Balguy for determination, with the like result of another similar percentage a fortnight since. The cases having been proved, Mr. Balguy intimated that he had recently, in similar cases of only 10 per cent certified as that of water adulterated with milk, decided upon not convicting, but dismissing the summonses on payment of costs.—Mr. Farnfield said that he understood the quality of the milk was analysed from the standard of the very poorest milk.—Mr. Balguy said the question had been raised in that court and elsewhere as to the differences that occurred in the water in milk where the animals were fed on the same kind of food, and it was the opinion of scientific men, among whom were Professor Voelcker, that these differences existed so far as 10 per cent was concerned. He had consulted other magistrates upon the point, and they had agreed with him, but in flagrant cases there would be no hesitation in conviction. He would admit that he had imposed penalties in cases of 10 per cent adulteration being given in certificates, and he wished afterwards he had not done so. In dealing thus with these cases, he held that the District Boards were only performing the duties required of them in taking proceedings, and no offence was implied in dismissing the summonses on payment of the costs. This course was agreed to in both cases."—*Kentish Mercury*, July 10, 1875.

NOTICES OF BOOKS.

Annual Record of Science and Industry for 1874. Edited by SPENCER F. BAIRD. London: Trübner and Co.

THE rapid progress of discovery and invention, and the vast extent of the periodical, scientific, and technological literature of our day combine to render a work like the one before us absolutely indispensable. We have on a former occasion declared Mr. Baird's *Annual Record* to be the best compilation of the kind accessible to the English reader, and we see no reason for altering our opinion. Great care and judgment have been displayed in the selection of the matter, and of the sources whence it is taken. We do not find (as in some annual publications of this nature) paragraphs from ordinary newspapers placed on the same level with extracts from scientific journals and from the transactions of learned societies. Here and there we observe, it is true, sins against methodology in the classification of the matter, and one paragraph is twice repeated. But when we consider the difficulty of collecting and arranging such a mass of facts, we can only wonder that these oversights are not more frequent.

There is, of course, one drawback to which all works

of this kind must be liable. Much of the information is necessarily not very recent. But we must remember that the object aimed at is not to furnish the latest novelties, but to give in a compact and handy form a general oversight of the world's scientific work for the past year. One suggestion we would beg to make—as the book is published in London with a view to a circulation in Britain, we think the ordinary English orthography should have been followed.

The value of the book is enhanced by a copious index, an obituary notice of men of science who have died during the past year, and a list of the scientific works published during the same period, which, however, is by no means complete.

On the Composition of the Ground Atmosphere, with some Examinations of the Air in Smoking Cars. By Professor W. R. NICHOLS. Boston: Wright and Potter.

THE experiments on the composition of the air pervading soils and rocks, instituted by Professor Pettenkofer, have excited a very widespread attention, and in various localities chemists are engaged with similar investigations. Professor Nichols, at the request of the Local Board of Health, has been analysing the air below the surface of the soil in the so-called "Back-Bay lands" of Boston. A part of the city stands on made ground, the mud of the Back Bay having been covered over with gravel. Air obtained from the soil at various depths was found free from sulphuretted hydrogen, and the amount of ammonia was 0.00004 grm. to 5 litres of air. But the carbonic acid was in excess over that found in the atmosphere above the surface; the quantity being in one case 4.77 parts in 1000.

The investigation of the atmosphere of smoking-carriages in railway trains has not led to any decisive results. The author did not succeed in detecting either the fatty acids or any of the alkaloid bodies. The amount of ammonia in the air of smoking-carriages was found decidedly greater than in that of ordinary carriages; but the proportion of carbonic acid, on the other hand, was somewhat smaller.

We must confess that we attach no very high value to these results. Railway carriages differ in their cubic contents, and very greatly in their ventilating arrangements. It would be necessary to get two carriages exactly alike in size and construction, and containing each the same number of passengers—smokers in the one case and non-smokers in the other—before a safe basis for analysis could be obtained. The difference between the atmosphere of a smoking-carriage and of an ordinary carriage depends, doubtless, as the author observes, on substances too minute in quantity to admit of determination.

CORRESPONDENCE.

MELTING-POINTS OF FATS.

To the Editor of the Chemical News.

SIR,—From the papers which have recently appeared in the *CHEMICAL NEWS* (vol. xxxi., pp. 205, 226, 227) "On an Easy Method of Taking the Melting-Points of Butter and Other Fats;" "A Method of Determining the Fusing-Points of Fats;" and "On a Method of Taking the Melting Points of Fats;" it appears that certain characteristic phenomena of the fusion of these substances have escaped the observation of the authors of these papers, and that certain apparent anomalies have in consequence been ascribed to causes other than the real ones.

In a paper which appeared in the *Journ. Chem. Soc.*, vol. v., p. 197, and also in the *Comptes Rendus de l'Academie*, I formerly pointed out these phenomena as seen in the fusion of comparatively pure glycerides, and showed that

they depend upon the property of these substances to assume under the influence of heat different modifications, which, for reasons that need not be here entered upon, I called *isomeric*, but which will be better understood now if designated *allotropic*.

In the course of an enquiry by which it was proposed to ascertain how far this property attaches to glycerides when mixed, as in the natural fats, and if it attach to them whether it exercises any important function in the economy of living animals and plants, I have made some observations on butter, pork-fat, and mutton-fat, in their natural state—separation of the caseine and tissue being understood—the results of which may be of interest at present.

Each of these substances is capable of assuming at least two allotropic modifications. There is also a third condition of each; but whether this is a specific modification, or only a mixture of the other two modifications, cannot be affirmed at present. It is, however, a remarkable fact that the temperature at which a fat in this condition melts has been universally accepted as *the* melting-point of the fat. For the purpose of identifying it relatively to the other melting-points, I will speak of this one as the second melting-point, and of the other two as the first and third respectively in the order of the temperatures at which they occur; the several modifications of the fat being also designated first, second, and third, according as they melt at the first, second, or third of these points.

If a specimen of butter, the second melting-point of which lies at 31.2°C ., be heated to 60° , and then solidified by powerful exposure to a temperature not exceeding 14° or 15° , it will melt at 17° . This melting is most readily made visible by plunging a capillary tube containing a portion of the substance into water at that temperature. If the substance be now kept within the range of temperature from 17° to 20° , it solidifies, and in doing so passes more or less completely into an allotropic modification, the second, which melts only when the temperature rises to 31.2° . If the liquid formed by fusion at this point be kept for some hours at a temperature not varying more than 2° or 3° on either side of 31.2° it becomes opaque, a great part of it solidifying as crystals, the third modification, which retain their opacity till the temperature rises to 40° , or upwards, according to the length of time at which the substance has been kept at a temperature about 31.2° . I have reason to regard the crystals formed in this manner as identical with those deposited in an ethereal solution of butter, which melt at 53.7° according to their state of purification.

After being heated to upwards of 60° , and solidified by cooling below 20° , pork-fat melted at 27.8° ; passing into the second modification it melted again at 37.8° . Long continued heating near this temperature converts so small a proportion of this substance into the third modification that any consequent elevation of the melting-point of the mass cannot be determined with precision.

Mutton-fat, after exposure to a temperature presumed to be higher than any of its melting-points, and subsequent solidification at a temperature presumably below all of them, melted at 39° , solidifying again while the temperature rose slowly to 52.3° , where it melted a second time, and when kept for some hours within a range of temperatures not exceeding 3° on either side of this second melting-point, solidified again, and then melted only when the temperature rose to 57° . It thus solidified only when the temperature fell below all three melting-points, unless the cooling were much retarded. In all cases the temperature at which solidification takes place determines the *modification*, and consequently the melting-point of the substance.

The glycerine fats as occurring in nature consist of a mixture, the constituents of which are not all equally susceptible of allotropic modification; the phenomena of their allotropy are consequently more complicated than those of any one of their constituents; but anomalies

such as an alteration of their melting-point by the action of drying or by shaking *per se* which Dr. Tripe and Mr. Heisch met with, have not come within my observation.

I infer from Mr. Heisch's paper, and from Dr. Redwood's reference to my experiments reported in CHEMICAL NEWS, vol. xxxi., p. 257, that when Mr. Heisch read his paper, he had not seen a full account of the methods which I employed for determining the melting-points of fats and the fluidity of melted fats. If he had he would have found that I had used tubes such as he recommends; but that, under circumstances, and for reasons, which I specified, I gave a preference to tubes in which the fats were protected from contact with the surrounding water.—I am, &c.,

PATRICK DUFFY.

Anglesea Road, Ipswich,
June 28, 1875.

SOLIDS IN MILK.

To the Editor of the Chemical News.

SIR,—My object in writing a note on the minimum of solids in milk was not to controvert any of Mr. Wanklyn's statements; if such had been my object, I should have first remarked that Mr. Wanklyn takes as his standard 9.3 per cent of "solids not fat," and then quoted the following examples:—

| | Total Solids. | Fat. | Solids not Fat. |
|--|---------------|------|-----------------|
| No. 4. Average sample from several well-fed cows on a rich farm in Cheshire; March | 12.90 | 4.40 | 8.50 |
| No. 5. Country milk; February .. | 12.35 | 3.74 | 8.61 |
| No. 6. Cheshire milk, stall fed; January | 12.46 | 4.00 | 8.46 |

Anyone who accepted Mr. Wanklyn's generalisations as rules, would declare that these samples were adulterated with 8 or 10 per cent. of water; whereas they were unusually rich samples from uncommonly well-fed cows. My object in writing to the Society of Public Analysts was to show (to those who think it better that some who add a small quantity of water to rich milk should go unpunished, than that one innocent person should be unjustly fined), that the limit accepted by the Council of the Society "must be used with great caution in instituting proceedings," when the deficiency below that limit is small. The Council's limit is thus expressed: "*Milk* shall contain not less than 9.0 per cent, by weight, of milk solids not fat, and not less than 2.5 per cent of butter fat." These make a total of 11.5 "solids not fat." I quoted three cases which were deficient either in fat or other solids, or in both; and since the note was written, some months ago, I have met with the following instructive cases of pure milk, fairly taken:—

| | Total Solids. | Fat. | Solids not Fat. |
|---|---------------|------|-----------------|
| No. 7. | 11.00 | 2.70 | 8.30 |
| No. 8. Old cow, badly fed; yielded only 3 pints | 11.00 | 2.14 | 8.86 |
| No. 9. Half-starved middle aged cow; yielded 2 quarts.. | 10.48 | 2.31 | 8.17 |
| No. 10. Average of several half-starved cows | 11.10 | 2.33 | 8.77 |

The following authentic cases have total solids below my minimum of 11.0, and the fat below the Council's minimum of 2.5; but escape if we take the standard of 9.0 solids without limiting the fat:—

| | Total Solids. | Fat. | Solids not Fat. |
|------------|---------------|------|-----------------|
| No. 11. .. | 10.27 | 1.29 | 8.98 |
| No. 12. .. | 10.67 | 1.09 | 9.58 |

Thus it appears that it is not safe to assert, on analytical grounds alone, without corroborative proof, that a sample of milk is adulterated with water, unless it contains below 11.0 per cent of total solids as well as below 9.0

per cent of solids not fat; nor even then, if it contains so much as 2·7 per cent of fat.—I am, &c.,

J. CAMPBELL BROWN.

Royal Infirmary School of Medicine,
Liverpool, June 29, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The recent correspondence upon mineralogical nomenclature and doubtful minerals, which has come before the readers of the CHEMICAL NEWS, shows very plainly the great need there is of a *Mineralogical Society*. Mineralogy is no longer a mere branch of geology, and it cannot expect to receive a proper amount of that kind of support and advancement which results from scientific association, while its students are content to be swamped in the Geological Society by the enormous preponderance of palæontological geologists.

A *Mineralogical Society of England* might fitly grapple with the questions lately brought before your readers; but those who know what the fortnightly meetings of the Geological Society are, would have little expectation of any good result from a discussion of such details at those meetings.

If Messrs. Maskelyne, Smyth, Forbes, and a few others, would only agree together to promote the formation of such a society, I feel sure that they would be at once joined by a large number of English mineralogists of lesser note, that the long lists of "doubtful minerals" would be speedily reduced, and that mineralogical nomenclature would soon be placed upon a more reasonable basis.

With reference to the Appendix B of T. A. R.'s letter in the CHEMICAL NEWS of last week, permit me to inform him that the *soda tungstate* from E. Pool Mine is a *chemical product*, and not a mineral.—I am, &c.,

J. H. COLLINS.

Truro, July 12, 1875.

ACTION OF THE GALVANIC CURRENT ON THE ORGANS OF SENSATION.

To the Editor of the Chemical News.

SIR,—In the report of the proceedings of the Physical Society contained in your valuable paper (CHEMICAL NEWS, vol. xxxi., p. 13), I read an account of Dr. Stone's communication "On Subjective Sensations of Taste," in which, after satisfying himself that no zinc is dissolved by the saliva in the production of the "galvanic taste," the author states that, "it could hardly be referred to chemical action, but must result from direct stimulation of the sensory apparatus," &c. I beg to refer that gentleman to my paper in the *Comptes Rendus* of the Paris Academy for Nov. 9, 1874, p. 1072, entitled "Action du courant électrique sur les organes des Sens," in which he will find that his conclusions have been anticipated.—I am, &c.,

T. L. PHIPSON, Ph.D.

London, July 11, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxx., No. 24, June 21, 1875.

This issue contains no papers, being filled up with notices of the different prizes awarded by the Academy of Sciences.

Bulletin de la Societe Chimique de Paris,
No. 11, June 5, 1875.

Action of Water upon Uric Acid.—M. L. Magnier de la Source.—In seeking to determine the coefficient of solubility of uric acid, both in pure water and in water acidulated with uric acid, the author has observed certain facts which seem to indicate the dissociation of uric acid in very dilute solutions. He draws the following conclusions from his experiments:—That uric acid in very dilute solutions has a variable coefficient of solubility, the higher the more dilute the solution. This increase of the coefficient of solubility appears due, at first, to the production of a more soluble hydrate, and ultimately to the dissociation of that hydrate into urea and dialuric acid, easily characterised by the insolubility of its potash-salt and the property which it possesses of becoming transformed into an iso-alloxanate. This dissociation is considerably accelerated under the influence of heat, particularly in presence of potash. These operations must be carried on in the absence of air.

New Body found in Urine after the Ingestion of Chloral Hydrate.—MM. Musculus and De Mering.—The composition of this body is—

| | |
|------------------|-------|
| Carbon | 31·94 |
| Hydrogen | 4·56 |
| Chlorine | 26·99 |
| Oxygen | 36·50 |

Unequal Solubility of the Different Faces of the Same Crystal, and on the Relation existing between this Property and certain General Principles of the Natural Sciences.—M. L. Pfäundler.—The author's views may be summed up as follows:—Building upon the theory of Clausius as to the state of aggregation, he admits that liquid molecules are in a state of unequal movement. Some of them possess a greater *vis viva* (temperature), and others a less. What we call the temperature of the liquid is merely the mean temperature of the totality of the molecules. The molecules of a crystal are also in motion around certain positions of equilibrium; their state of motion (that is to say, their temperature) varies within certain limits. It is not equal at all points and in all directions. When this difference rises beyond a certain limit, the molecule is torn away and becomes liquid. Liquid molecules clash, in their movements of translation, against the crystalline molecules. From these shocks may result three consequences—either there is simple reflection of the impinging molecule, or adherence, or displacement of the molecule struck. The author has shown in detail.* The crystal does not change in weight, provided that in the same time as many molecules are removed as remain adhering on the other hand. The state of equilibrium of a crystal in its saturated solution is, therefore, not a static, but a dynamic equilibrium. Its weight remains constant, not because there is neither solution nor crystallisation, but because the two phenomena mutually compensate each other. The crystal begins to dissolve when circumstances become favourable to produce impacts which determine the separation of solid molecules (*e.g.*, when the temperature, or, in other words, the *vis viva*, of the molecules increases), or when the impacts which occasion the adherence of molecules become more rare (*e.g.*, when the solution is diluted). Reduction of temperature and concentration disturb the equilibrium in the opposite direction, and the crystal increases. If the mean vibratory condition is the same on the surface of the crystal at all points and in all directions, there will be, on the average, at every part of the crystal, as many conditions favourable to the fixation as to the removal of molecules, and consequently the crystal will not change its form. If this condition is not fulfilled, the conditions favourable to fixation may have the advantage in certain places, and those favourable to displacement in others. This explains the growth of certain parts at the expense of others, and consequently the successive transportation of material molecules by the solution, without

* *Sitzungsberichte der K. Academie der Wiss. in Wien*, lix.

the latter requiring to be supersaturated, even temporarily, or to change in temperature. The faces of the crystal, which possess conditions favourable to resistance, as regards the impinging molecules, preserve themselves and repair themselves at the expense of the others. M. Lecoq de Boisbaudran has extended his view even to the gaseous state. The author has done the same in the memoir above cited, and has, for instance, explained how iodine in powder surrounded with vapour may, without change of temperature, change into larger crystals. The same interpretation may be given for the slow crystallisation of solid amorphous bodies. These phenomena, and others also, may be regarded from a much more general point of view. This the author has sought to develop in his treatise, entitled "The Vital Competition (Concurrence) between Molecules: a New Contribution to Chemical Statics."* He has shown, among other things, that the principles of Darwin are applicable also in the molecular sphere. The forms and the combinations which possess conditions most favourable to existence are those which maintain themselves. If the conditions change, the forms and the combinations change also; consequently, the combinations formed by the strongest affinities are, by preference, preserved. But in this case, also, the right of the strongest does not always prevail. As there are in the animal kingdom forms which are preserved because they know how to escape or to hide themselves, so in chemical reactions, in spite of energetic affinities, compounds are maintained because by their volatility they are withdrawn from inverse reactions, or because by entrenching themselves in the crystalline form they are removed from the impulse of impinging molecules. Thus the views of the great Berthollet, on the influence of volatility (elasticity) and of insolubility (cohesion) on the progress of chemical phenomena, are found complemented and sustained by the application of conceptions by which Clausius and Darwin have enriched natural science in regions apparently widely remote from each other.

Researches on the Selenites.—M. F. Nilson.—Already noticed.

Caustic Soda.—The firm of Grüneberg and Vorster, of Kalk, near Cologne, have patented, in England, a process for obtaining caustic soda by passing superheated steam over a heated mixture of common salt and of alumina, or its hydrate.

Copying Pencils.—M. Ch. Viedt.—Pencils which give traces capable of being copied like those of copying inks are made from graphite ground up in water to a fine paste, of finely-powdered kaolin, and of a highly concentrated solution of an aniline violet-blue soluble in water.

Analysis of Burnt Pyrites.—M. G. Lunge.—According to the analysis of M. Gibb, the pyrites of San Domingos, of Tharsis, and of Rio Tinto contain, on an average, 47 to 49 per cent of sulphur.

| | Copper. Per cent. | Silver. Ozs. per ton. |
|-------------------|----------------------|--------------------------|
| Rio Tinto.. .. . | 3.80 | 1.20 |
| Tharsis | 3.50 | 0.75 |
| San Domingos.. .. | 3.70 | 0.75 |

The burnt ores, as delivered by the sulphuric acid makers to the copper-works, have the following composition:—

| | Rio Tinto. | Tharsis. | San Domingo. | Ytteroen, Norway. |
|---|---------------|----------|-----------------|----------------------|
| Copper } Calculated as { | 1.6500 | 1.5000 | 1.5500 | 1.01 |
| Iron } $\text{Cu}_2\text{Fe}_2\text{S}_4$ { | 3.6400 | 3.2300 | 3.7600 | 3.33 |
| Sulphur | 3.5300 | 3.1500 | 3.6200 | 3.10 |
| Oxide of copper .. | 2.7500 | 2.5600 | 2.7000 | 0.39 |
| " zinc | 2.0200 | 0.5500 | 0.4.00 | 6.46 |
| " lead | 0.4700 | 0.7000 | 0.8400 | 0.06 |
| Silver | 0.0037 | 0.0023 | 0.0023 | — |
| Oxide of cobalt .. | 0.0070 | 0.0320 | 0.0330 | — |
| " bismuth | 0.0130 | 0.0100 | 0.0130 | — |
| Lime | 0.2000 | 0.2500 | 0.2800 | 2.30 |
| Oxide of iron .. | 77.4000 | 77.0000 | 78.1500 | 68.06 |
| Sulphuric acid (SO_3) .. | 6.1000 | 5.2500 | 5.8000 | 6.56 |
| Arsenic acid | 0.2400 | 0.1700 | 0.2500 | 0.05 |
| Insoluble remnant .. | 1.4500 | 5.8500 | 1.8500 | 8.74 |
| | 99.4700 | 100.2600 | 99.3200 | 100.06 |

* Poggendorff's *Fubelband*, p. 182; and Pogg. *Annalen*, cxxxi., p. 55.

On Certain Mordants Used for Dyeing Cotton.—M. Ch. Girard.—The mordants most generally used for dyeing cotton aniline blue are as follows:—For diphenylamin blues, the sulpho-conjugated salt of the blue being a calcic or barytic compound, it is sufficient to mordant the cotton in a solution of tannin at 3 per cent, and to pass directly into a solution of alum neutralised with carbonate of soda, then dye directly in the aqueous solution of the blue; brighten, wring and dry. For alkaline blues of which the sulpho-conjugated salts are generally sodic, or ammoniac compounds, we take likewise an aqueous solution of tannin containing 3 per cent of the weight of the cotton; keep at a boil for a quarter of an hour, wring and dry. Then pass the cotton into a bath containing $1\frac{1}{2}$ kilo. alum, 250 grms. tartar emetic, 750 grms. soda crystals, and 250 grms. tartaric acid. These ingredients are dissolved separately, and finally the colour is added. The bath is heated from 65° to 70° , the cotton is entered and worked while the temperature is allowed to sink. The bath serves continuously, more mordant being added as it becomes exhausted. Heavy shades are dyed first, then mediums, and then pale shades. To dye cotton with saffranin and night-green, the cotton is first passed into a solution of bichloride or oxymuriate of tin marking 2° (B.?), wrung, passed into a tannin bath, wrung, and then passed into the dye-bath. Cotton may also be mordanted in a solution of nitrate of urea (2 grms. per litre of water) at a boil; wrung, and passed into a solution of biphosphate of lime at 5 grms. per litre of water; wrung, and entered in the colour bath. In this manner almost all the aniline colours give very bright colours.

Action of Baryta upon Certain Mineral and Organic Compounds Contained in the Products of the Beet.—M. P. Lagrange.—The hydrate of baryta not merely removes all phosphoric acid from the juice of the beet, but acts also upon certain organic impurities, greatly improving the quality of the produce.

Lamp of Bisulphide of Carbon and Nitric Oxide.—MM. Delachanal and Mermet.—Taken from the *Comptes Rendus*.

On the Same Subject.—M. E. Sell.—From the *Berichte der Deutschen Chem. Gesell.*

On the Decomposition and Preservation of Wood.—M. Max. Paulet.—See *Comptes Rendus*, vol. lxxx., p. 23.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 6, June 10, 1875.

Process of Gilding.—Place in a plate leaf-gold, add a little honey, stir the two substances carefully together with a glass stopper, the lower end of which is very flat. Throw the resulting paste into a glass of water mixed with a little alcohol, wash it and leave it to settle. Decant the liquid and wash the deposit again. Repeat the same operation until the result is a fine, pure, and brilliant powder of gold. This powder, mixed with common salt and powdered cream of tartar, and stirred up in water, serves for gilding.

Another Method for Gilding.—Boutet de Mouvel.—Dissolve in *aqua regia* 1 grm. of fine gold, previously rolled out very thin, in a porcelain capsule heated on the sand-bath and concentrated till it is the colour of ox-blood. Add a half litre of distilled water, hot, in which have been dissolved 4 grms. of white cyanide of potassium. Stir with a glass rod, and filter the liquid through unsized paper. To gild with this liquid, it is heated a little above luke-warmness, and the articles to be gilt are immersed in it and supported upon a piece of very clean zinc.

Spectrum of Yttrium, Didymium, and Lanthanum.—R. Taleu.—Since in the two spectra these rays are very different in intensity, and since the most characteristic rays of the spectrum of a substance are wanting in that of another substance, we can explain these coincidences

neither by the mutual impurities of the two bodies in question, nor by those of foreign bodies, of which the principal rays are known. The author is led to believe that these coincidences are quite apparent, and that, although the dispersion was produced by six prisms of flint, they depend solely on the fact that the dispersive power of the spectroscope was not sufficient for delicate determinations. The following examples show how near to each other the rays of different bodies may be:—

| | | | |
|----------|------------|----------|------------|
| Di | 4901.0 (2) | Di | 4882.5 (2) |
| Y | 4899.5 (1) | Y | 4881.0 (1) |
| La | 4899.0 (1) | | |

There is no reason why the difference in the wave-length of the neighbouring rays may not be still less than 0.5 of the unity selected, 0.0000001 m.m. The tables given will, in the opinion of the author, suffice to distinguish the metals in question perfectly from each other.

Transformation of Static Electricity into Dynamic Electricity.—M. R. Bichat.—Instead of producing sparks of static electricity by means of a Holtz machine, they may be produced by means of a second Ruhmkorff's coil. The thick wire of the second coil is connected with the extremities of the fine wire of the first.

Moniteur Scientifique du Dr. Quesneville, July, 1875.

On Fluoresceine and Phthaleine Orceine.—Emile Fischer.—A very valuable paper, but, from its great length, not suitable for insertion.

Analysis of Crude Anthracen.—G. E. Davis and T. H. Davis.—A translation from the English.

Lessons on the Manufacture of Beer, Regarded from a Chemical Point of View.—Dr. J. Graham.—A translation of the course of lectures delivered before the Society of Arts.

Analysis of Wines.—Dr. Macagno.—Already noticed.

Detection and Determination of Methylic Alcohol in presence of Vinic Alcohol.—Alfred Riche and Charles Bardy.—Already noticed.

The Phylloxera vastatrix.—A collection of extracts from official documents on the progress of the Phylloxera and the remedies proposed.

Action of Liquids, Alimentary or Medicinal, upon Tin Vessels and Glazes containing Lead.—M. Fordos.—Already noticed.

Prohibition of the Importation of Coal-tar Colours into Russia.—By a Ukase, dated February 25, the importation of aniline colours not crystallised, *i.e.* in paste, in fragments, or powder, is forbidden, as also the sale of similar products manufactured in Russia. Artificial alizarine is classed with non-crystallisable aniline colours.

MISCELLANEOUS.

Method of Obtaining a Constant Temperature.—Professor Cooke, of Harvard College, in experimenting on the vermiculites, wished to obtain a constant temperature of 100° C. For this purpose he employed an electric regulator of very simple construction. The current is made or broken by a very slight rise or fall of mercury in a U-tube connected with a glass bulb within the air-bath. By means of a pressure-tap which closes an open L of the connecting tube, the air within the bulb may be confined as soon as the bath reaches the required temperature. After this a very slight increase of temperature raises the mercury column sufficiently to close the electric circuit, and then the current shuts the cock which regulates the supply of gas to the burner under the bath. The chief advantage and the novelty of the apparatus is to be found in the simplicity of this stop-cock, which was suggested by Professor H. B. Hill.

It consists of an ordinary chloride of calcium tube placed horizontally, and closed at the larger end by a rubber stopper, which allows a considerable freedom of motion to a smaller glass tube passing through it; by this the illuminating gas enters the chloride of calcium tube, from which it passes to the burner. When the current is closed, an electro-magnet acting on an armature attached to the outer end of the small tube plunges the curved inner end beneath the surface of some mercury in the bulb of the chloride of calcium tube, and thus shuts off the main supply of gas; although a small orifice in the side of the inner tube allows a sufficient flow to keep the flame under the air-bath alive. The variation of the temperature of the air-bath does not ordinarily exceed one or two degrees during periods of fifteen to twenty hours, even under great variations of pressure in gas mains.

United States Board for Testing Iron, Steel, &c.—The Committee for investigating those modifications of the various properties of the metals which are produced by changes of temperature, are desirous of supplementing their experimental researches with such results of other experimental work and of observation as may be obtainable from authentic sources; they, therefore, solicit such contributions from investigators and observers as may be deemed valuable as assisting in the task assigned them. The behaviour of rails and of machinery exposed to the extremes of temperature observed in northern latitudes, where exposed to wear or to breakage, will be likely to afford valuable data. The character of the fracture and the texture of the abraded surfaces, as well as the statistics ordinarily collected, should be noted. Specimens exhibiting peculiarities of behaviour or appearance, and photographs of masses which it may not be convenient to forward, will be of value. Where exact quantitative analyses of metals exhibiting unusual characteristics can be given, they will add effectively in the determination of the causes of such peculiarities. The statistics of well-managed railroads are expected to afford useful and reliable information. Rolling mills producing rails and other forms of rolled iron which are tested by the drop may be able to furnish more accurate statements of the effect of changes of temperature in modifying resistance to shocks. Some experimental work has already been done in this field, and it is desired that the results of such researches may be communicated in as great detail and with as much accuracy as possible. Published monographs, reference to papers published in scientific, engineering, or other periodicals, and unpublished papers, will be received as valuable contributions. All assistance rendered the Committee in the endeavour to ascertain the character of the change of the force of cohesion produced in the metals and their alloys by variation of temperature, to determine the mathematical expression of that law, and to obtain such formulæ, either exact or approximate, as will make these results conveniently and practically available to engineers and constructors, will be properly acknowledged. This Committee consists of Prof. R. H. Thurston (Chairman), L. A. Beardslee, and Q. A. Gillmore.

Metropolis Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of the City of London, and the Metropolitan Board of Works the results of the daily testings of the gas supplied from the several gas-works of the Chartered, the Imperial, and the South Metropolitan Companies during the last three months, from which it appears that the average illuminating power of the gas at the several testing places has been as follows:—Common gas at Beckton, North Woolwich, 17.63 standard sperm candles; at Friendly Place, Mile End, 16.76 candles; at Ladbroke Grove, 16.97; at Carlyle Square, Chelsea, 16.62; at Camden Street, Camden Town, 15.76; at Graham Road, Dalston, 16.82; at Bruce Terrace, Bow, 16.27; and at Hill Street Peckham, 15.70. The Cannel Gas of the Chartered Company at Millbank

Street, Westminster, has been equal to 21.13 standard candles. In all cases and at all times the illuminating power of the gas has been equal to the requirements of the several Acts of Parliament. As regards purity Dr. Letheby reports that the gas at each of the testing places has been constantly free from sulphuretted hydrogen, and that the average amounts of sulphur in other forms than this have ranged from 9.04 grains per 100 cubic ft. to 18.28 grains, the following being the average proportion at the several testing places:—Beckton, 10.35 grains; Friendly Place, 9.42; Ladbroke Grove, 10.40; Millbank, 11.06; Carlyle Square, 18.28; Camden Street, 12.69; Graham Road, 13.35; Bruce Terrace, 9.04; and Hill Street, Peckham, 13.42. All these averages are below the prescribed quantities, but on one occasion the gas at Friendly Place contained an excess of sulphur, and the same was the case with the gas at Hill Street. On 14 occasions the gas at Carlyle Square was overcharged with this impurity, and on 7 occasions at Camden Street. At both of these places the excess has been the subject of appeal by the Imperial Gas Company, and the Chief Gas Examiner has certified that in the case of the gas at Carlyle Square, the excess of sulphur was occasioned by the unavoidable derangement of the purifier during the alterations which were being made at the works of the Company for the purpose of meeting the necessities of the ensuing winter; but in the case of the gas at Camden Street the excess of impurity was not the result of unavoidable cause or accident. The proportion of ammonia in the gas at all the testing places excepting Millbank has not exceeded the prescribed quantity of 2.5 grains per 100 cubic ft. At Millbank, however, there was an excess of this impurity, ranging from 4 grains to 6 grains per 100 cubic ft. of gas on four occasions.

TO CORRESPONDENTS.

V. C.—Suffolk's "Microscopical Manipulation" is published at the office of this paper, price 3s. 6d.
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THE CHEMICAL NEWS.

VOL. XXXII. No. 817.

IMPLEMENTS FOR FILTRATION.*

By P. CASAMAJOR.

I.—Filter Pump.

IN the *American Chemist* for April, 1874, I gave a description of a new apparatus which may be used as filter-pump or laboratory bellows. Since sending this communication I have used this apparatus almost constantly as filter-pump, but having very seldom to use it as bellows I have disconnected the two portions, and tacked the part which forms a filter-pump to the wall over a sink into which the water runs after leaving the aspirator. The portion used as bellows is, as explained in the article mentioned, a bottle closed by a cork having two holes, one to admit the aspirator, and the other a tube for carrying off the air. There is at the lower part a nozzle for getting rid of the water after the bubbles of air have been separated from it. As now modified, the cork which closes the mouth of the bottle bears two tubes, one reaching to the bottom and the other starting from the top of the bottle. This latter tube carries off the air, while the other, when the apparatus is in use, must be connected with the tube which carries away from the aspirator the water charged with bubbles of air. Beyond this brief mention we do not propose to call attention any further to this blowing apparatus, as it has no relation to the subject of filtration.

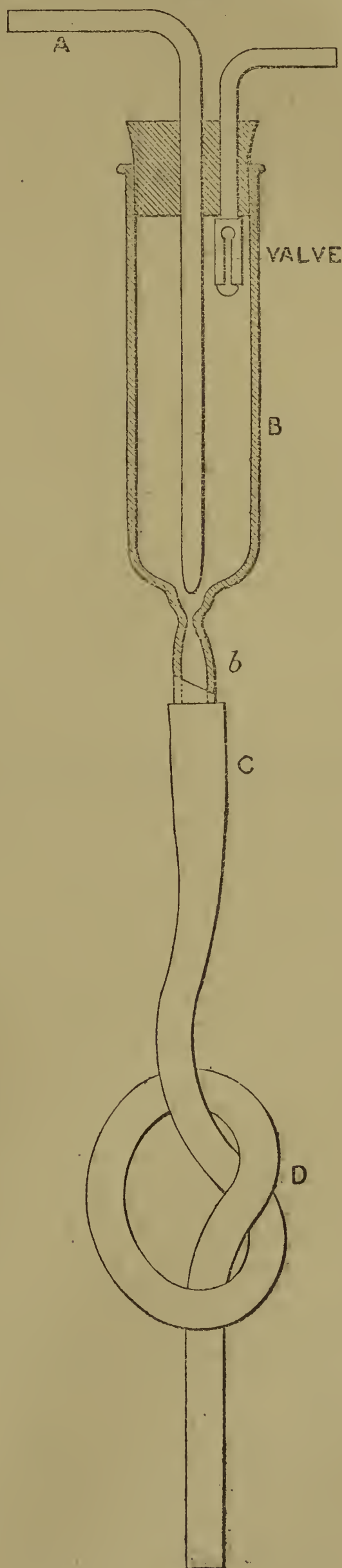
The filter-pump itself is very easily put up by using elements which are at hand in every laboratory, which circumstance induces me to call attention to it again, particularly as it has been much improved, and the results now accomplished are much superior to those previously announced. To give an account of the changes adopted I propose to give a brief description of this aspirator, and afterwards to call attention to the points that are of most importance if advantageous results are to be obtained.

The aspirator, as now used, is represented in Fig. 1, in which A is a tube which conveys water from the hydrant or from an upper reservoir. The extremity of this tube, through which the water escapes, has a contracted outlet, which gives increased velocity to the water as it enters the tube *b*, which forms the lower part of the vacuum chamber B. To the tube *b* is attached a rubber tube *c*, which is curved at D into a loose knot. The lower portion of *c* hangs over a sink into which the water is discharged after leaving the apparatus. Through the cork, which carries the tube A, passes also the vacuum tube E, which establishes a communication between the vacuum chamber B and the bottom of a funnel or a bell glass.

The first point of importance to be attended to, if we wish to obtain good results, relates to the shape of the lower extremity of tube A and to the size of the opening for the egress of the water. The best results have been obtained by making the lower end of A somewhat truncated (see Fig. 2), and making the hole in it not more than $\frac{1}{16}$ th of an inch in diameter. The tube should be elongated by heating over a flame until the interior diameter is reduced to about $\frac{1}{8}$ th of an inch. A cut with a file will sever the tube, after which the portion which is to form the extremity of A has to be heated again until the glass is softened, when, by pressing the end of the tube against any hard surface, it will become blunted and the hole will become contracted. The object of flattening the end of tube A is to cause the water to come out of the opening somewhat obliquely, which makes a better vacuum than when the water escapes from an elongated cone. The opening for the escape of the water is reduced to allow the pump to work with a smaller supply.

The tube *b*, which forms the lower portion of the vacuum chamber B, should be drawn to a diameter of about $\frac{1}{8}$ th of an inch at the narrowest part, which ought

Fig. 1.

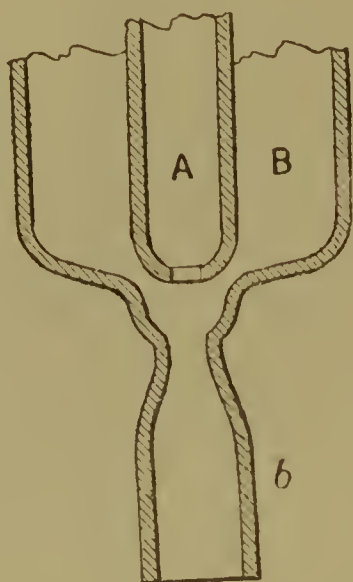


* Communicated by the Author.

to be immediately below the lower end of tube A, as shown in Fig. 2.

To the lower portion of tube *b* is attached a piece of rubber tubing loosely knotted, of which we have already spoken. The knot formed by this tube acts as a trap, which remains full of water while the aspirator works,

Fig. 2.



and prevents the introduction of air from below to satisfy the vacuum in vessel B.* This object I sought to accomplish formerly by dipping entirely in water the end of the tube carrying the water away from *b*; but this course is objectionable, for, whenever the pressure in the tube A diminishes, and the impact of the water on the tube *b* is not sufficient to maintain the vacuum in the chamber B, the water from below rushes up into the vacuum chamber, and when the tube which is a prolongation of *b* dips into a large body of water the vacuum chamber itself—and every vessel communicating with it—is in danger of being flooded. The advantage of using the trap formed by recurving the tube *c* is, that the quantity of water held in the recurved portion is only sufficient to fill a portion of the vacuum chamber whenever the water rushes up into it.

I have said that this aspirator may be constructed by using elements which may be found in any chemical laboratory. The only apparent exception to this is the vacuum chamber B, with its appendage, the tube *b*, but the difficulty of obtaining this piece is easily overcome by making the tube *b* of an independent piece of tubing, and connecting it to a vacuum chamber by passing it through a cork. The vacuum chamber may then be made of a glass tube having a diameter of 1 inch or 1½ inches, and closed by corks at both ends, the upper corks carrying the tubes A and E, while the lower cork will bear the tube *b*.

Many vessels may be utilised for making up the vacuum chamber B and its annexed tube *b*; I may cite as an instance a filter-pump I have in use, in which the vacuum chamber is a cylindrical bottle having a diameter of 1½ inches and a length of 5 inches—such a bottle as is used for exhibiting samples of refined petroleum. The bottom was knocked out by dropping an iron rod into the bottle, which operation left an opening which is now closed by a rubber stopper bearing the tubes A and E, while through the ex-mouth of the bottle passes the tube *b*. As the difference between the interior diameter of the opening and the exterior diameter of the tube *b* is only ⅓th of an inch, the space has been filled by passing the tube *b* through a piece of rubber tubing before inserting it in the vacuum chamber.

The vacuum chamber B may be of smaller dimensions than the one I have just cited. It is necessary, however, that its diameter should be sufficient to admit of its being closed by a cork capable of carrying both the tubes A and E. The capacity of the vacuum chamber should be such

that the water in the recurved rubber tube may find room in it whenever the flow in the tube A is suddenly checked.

To maintain the vacuum beyond the vacuum chamber, when the flow of water is checked or diminished, it is necessary to place a valve on the tube E. The valve adopted (see Fig. 1) is of the simplest description, and requires only a few minutes to construct it. It is made by closing the end of a glass tube by melting over a lamp, and on the side of the tube, about an inch from the end, making a hole with a file previously dipped in petroleum to prevent it from cracking the tube. Over this glass tube we then slip a rubber tube about an inch long and having a longitudinal slit about ¾ of an inch long. About one-quarter of the length of the rubber tube is left entire, which forms a ring to retain the rubber on the glass tube. The slit should be placed diametrically opposite the hole made on the side of the glass tube. When placed in this manner the rubber tube may be considered as a loose flap placed over the hole; it opens out when air is blown into the tube, and closes when the air is sucked out. To ascertain the best place in which to place the rubber tube over the opening, a few trials are necessary, by blowing and aspirating at the open end of the glass tube. If the hole in the glass tube is too near the ring or entire part of the rubber tube, the valve will not open when the air is blown in, while, on the other hand, if the side hole is too far from the ring, the valve will not close when air is aspirated from the tube. To prevent the slit from extending in time the whole length of the rubber tube, it should terminate at the end near the ring, in a round hole or a transversal slit.

In the description of this aspirator previously given (*American Chemist* for April, 1874), I said that it could only be used when the pressure in the hydrant was very high. I have, however, obtained very good results with moderate pressures since the improvements which have been described in this article were adopted.

The following table shows the results for different pressures:—

| Pressure in the Hydrant in lbs. | Vacuum in inches of Mercury. | Water spent per minute in litres. |
|---------------------------------|------------------------------|-----------------------------------|
| 2 | 2½ | 0.50 |
| 4 | 3½ | 0.75 |
| 8 | 5 | 1.00 |
| 16 | 10½ | 1.33 |
| 20 | 16½ | 1.45 |

I use habitually a pressure of 8 lbs., which produces all the necessary effects without straining the rubber pipes which connect the hydrant faucet to the tube A.

In calling attention to this simple and effective apparatus for the second time, I wish to have it well understood that I do not claim to have discovered any new principle or any application of a principle. My object has merely been to afford directions to enable any chemist, who desires to have a filter-pump, to make one for himself, in a short time and at a small expense.

(To be continued).

ON THE WIDE DIFFUSION OF VANADIUM AND ITS ASSOCIATION WITH PHOSPHORUS IN MANY ROCKS.*

By A. A. HAYES, M.D.

CHRISTIAN KEFERSTEIN, as early as 1834, had boldly stated the proposition that "all crystalline non-stratified rocks, from granite to lava, are products of the transformation of sedimentary strata," and later researches aid in confirming the truthfulness of this view.

Simply considered, all rocks consist of a basis material, generally simple minerals, such as compound silicates, aluminates, or even quartz, in various states of division,

* This trap is useless if the aspirator is well constructed; otherwise it increases the vacuum, but in no case is it hurtful.

* A Paper presented to the American Academy of Arts and Sciences.

united by a compound which acts the part of a cement, which through its composition is more easily acted on by ordinary agents than the particles of the mineral it unites.

This part of every rock engages attention, also, from its acting as a positive compound does in a simple mineral. It is complex in composition; usually it consists of silicates of protoxide bases. At one moment of time it binds the particles with great force; at another, under altered conditions, it relaxes its bonds, itself losing cohesion, crumbling and becoming an earth containing the elements necessary to vegetation, while the bonded materials drop to their condition before union.

Accepting Keferstein's expression in its fullest sense, I have applied the resources of analysis to a large number of rock aggregates, and the result of my experiments have shown the interest and extent of this field of inquiry. To do this, I have departed from the ordinary course of analysis, and applied a principle which, many years since, enabled me accurately to separate alkalies from mineral compounds. This principle is the adaptation of a definite mixture of agents, so that while one part of the mixture is searching for and dissolving the substance to be studied, the other part is holding in a semi-fluid state the larger part of the substance and allowing any reactions or adjustments of composition to take place. The subsequent solution and boiling determines the precipitation of compounds not soluble in the medium. This medium is subsequently decomposed and products divided.

Mode of Analysis.—The rock perfectly cleansed by washing and brushing, reduced to fine powder, is either dried for its combined water or taken in its natural state. A flux is prepared by melting 202 parts of potassic nitrate with 53 parts of sodic carbonate, both pure. The cooled mass, reduced to powder, absorbs about 0.004 part when exposed to the air, and must be kept in a closed bottle. This *basis* flux can be adapted to meet all cases of varied composition in minerals. 1 grm. of the rock or mineral is mixed intimately with 1.28 grms. or 2 grms. of this flux in a tall, narrow crucible of platinum, on which no action is exerted. The crucible, covered, is heated over an ordinary Bunsen table lamp, gently while intumescence continues: the heat increased, hissing ceases, a slow sintering follows, and in 12 to 20 minutes the action is over, about one-half of the whole power of the lamp being used.

The fused mass, mostly removed from the crucible by a looped platinum wire, with the crucible and cover are boiled in water. The basic silicates, more or less altered, remain; the soluble compounds dissolve, and the filtered solutions and washings, making 40 to 50 cc., are evaporated in a platinum basin to about 6 cc. To the hot solution, ammoniac chloride, a little in excess of the equivalent of sodic carbonate used, is added, from a titrated pure solution, the basin put on a water-bath, the contents evaporated, and carefully dried at temperature not exceeding 100° C. After the addition of the ammoniac chloride, the silicic acid gelatinises, and, in drying, passes out of combination with the alkalies. By subsequent boiling in water and filtration, the precipitated silicic compounds are obtained.

The filtrate and washings contain other combinations, which can be treated either in the normal state of acid ammoniac salts, or after the addition of a drop of ammoniac hydrate renders the solution neutral to test-paper. Numerous cases occur, rendering modifications necessary. Chlorine, bromine, iodine, sulphur, compel a choice of ammoniac salts. Many of the acid-forming metals are separated by their characteristic reactions from the residue of fusion. In general, if the solution of the result of fusion does not deposit silicic acid on the addition of an ammoniac salt, 0.25 grm. of silicic acid, with or without its equivalent of sodic carbonate, is added; because the displacement of other acids depends on the presence of an excess of silicic acid. The solution containing nitrites is delicately balanced, but it is always adapted to the

statical determination of phosphoric acid by the magnesia mixture, or its estimation volumetrically, in using uranic nitrate. The quantity of phosphoric acid present in mineral or artificial forms of compounds can thus be accurately obtained, and the most compact aggregates do not resist solution.

Wide Distribution of Phosphorus.—In applying this mode of analysis to a great variety of rocks, it soon became evident that phosphoric acid is widely distributed. In some cases the basis, as well as the cementing part, of a rock contained it, so that adherence to the plan of seeking it in classified rocks was not possible. Associated with silicates of the more basic earths and the protoxides of metals, it is found in all the clays, the new and old lavas, trachytes, slates,—from the most fissile to the most compact,—shales, ashes of coals; in the rocks formed of quartz, felspar, and mica; in aggregates where felspar is replaced by quartzite, and in those containing chlorite. The well-known conglomerates of Roxbury, and a siliceous slate reposing near it, contain phosphates.

In the opaque felspars, the ancient porphyries of Rome and Carthage, phosphates occur; but the glassy and rose-coloured varieties have not afforded it. The lepidolite of Paris, Me., contains it; furnace products, slags from copper and zinc, afford it. This list might be extended, without indicating any law relating to the affinities, which may perhaps be discovered as the observations are multiplied. We have in phosphatic salts in rocks another consolidating material, and an element of change.

Vanadium Associated with Phosphorus.—In many of the analyses made after the method described, another acid was found associated with phosphoric acid, and this was easily proved to be a compound of *vanadium*. The frequency of its occurrence as acid or oxide, its well-marked characters as a changeable body, the colours of its compounds and mixtures, give great interest to this discovery. Owing to its association with proto salts of manganese and iron in rocks, it proves to be active, first as a binding, and secondly as a disintegrating, agent. It is a matter of surprise that the dissemination of vanadium has not before been noted, especially since its later classification with phosphorus leads to such a conclusion.

When the rocks treated by the above method for phosphoric acid contain manganic compounds, if the second filtrate, balanced by ammoniac salts, has any yellow tint, vanadic acid salts are almost surely present. It occurs with phosphoric acid in most of the mineral bodies named above. The physical character of colour of the rock is the only indication I now know. The green and plum colours of slates and porphyries; the greenish epidote colour of many aggregates; the changed colours seen in sandstones, and especially in roofing slates, from world-wide localities, are guiding marks merely. My observations have been quite numerous, and as yet no proper *ore* of vanadium has been found, but sources of economical separation have been suggested.

As vanadium occurs in many well-trodden paths, I deemed it important to devise a direct way of obtaining it, in which no metal and the fewest reagents are employed.

Process.—Crush in the diamond mortar 1 to 1½ grms. of greenish slate to a fine and coarse powder; place in a watch crystal, and wet thoroughly with a solution of one-fourth sulphuric hydrate, leaving a little excess. Expose freely to dry, warm air,—sunshine, if possible; and, if the slate is acted on, after 2 to 4 days, when the mass is nearly dry, the salts formed crystallise. Under a lens, a number of green or bluish-black spherical crystalline aggregates, unlike any other matter present, will be seen. These are a double salt, in which blue oxide of vanadium exists; and from such a small weight often enough crystals can be picked out for showing the characters of vanadium compounds. It is best to use several differing specimens, which by their colours indicate proto-silicates,

and to be sure that they have been carefully washed, as granites are often invested with a lichen of a hemispherical form. One is often surprised to see the number of these crystals extruded from the mass of salt, and formed under constraint. The oxidised rocks do not afford these crystals, but we see bands of yellow vanadium compounds, denoting the condition of the substance.

The ordinary tests of vanadium are best applied to the vanadates, and among them the gall test is delicate and discriminating. If the greenish-black precipitate it forms in acid solutions be burned, the insoluble oxide obtained (when the precipitate is entirely free from any chloride) has characteristic reactions with acids, and in the blow-pipe flame with fluxes. The salts of vanadium in mixture with manganous salts, precipitated by excess of ammoniac hydrate, afford a blue solution above the oxides, rivalling that of cupric oxide.

By oxidising the blackish-blue salt obtained by sulphuric hydrate, the yellow compounds form, and may be tested under both modifications.

The vanadate of ammonia present in the balanced solution from the silicates, by the mode of analyses described above, may be separated by over-saturating the solution with ammoniac chloride, when ammoniac vanadate separates; although phosphoric acid is present. From the vanadate other combinations of vanadium may be formed. The solution does not then respond to the gall test; and the ammoniac vanadate separated, when heated, leaves vanadic acid. The deposit caused by tinct. galls may be calcined for V_2O_5 . In testing for phosphoric acid, in this mixed solution, the magnesia mixture does not respond at once, unless the device of Wollaston be used; and, in strong solutions, plumose vanadates form. If heat is applied to the salts in mixture with chlorides, much of the vanadium will be lost. In most of the rocks containing phosphorus, vanadium has been found associated. Manganese is also a congener; and, without repeating here the list of rocks, I can promise in a future paper to give a tabulated series.

In Utah, in the Tintic district, there is a chalcedonic rock, with brown ferric and cupric ore. In the brown part of this ore both phosphorus and vanadium are abundant. The presence of vanadium, in crusts on copper rock of Lake Superior, announced some years since, by my late friend J. E. Teschemacher, has been lately confirmed. It is present in light greyish earth-like substance of the datholite beds in the Calumet and Hecla mines. At present it appears that vanadium is as common a constituent of rocks as manganese.

Vanadic Compounds in Water.—The beautiful suburb of Boston, Brookline, owes its varied surface and scenic effect largely to *water action* in forming the gravel drift into elevations and depressions, having curved and graceful lines. This drift presents us with a magazine of rock aggregates, which not only supply the laboratory, but, in various cuttings, allow us to watch the influence of air, frost, and water on the rocks; which, stable in their beds, become changed, even rapidly, on exposure to these agencies. This gravel, permeated by air, changing under every variation of pressure, is powerfully oxidising; and the rain water, even if coloured on entering it, becomes colourless and sparkling at eight yards below the surface. The gravel contains strata and inclined dykes of extremely finely divided micaceous earth, or "quicksand," in which the water circulates and passes to the ocean at different levels. An *average* result of partial analyses is:—1 litre affords by evaporation and drying at 100° 0.350 grm., of this amount 0.182 grm. is nearly insoluble matter; 0.168 grm. again dissolves in water, and contains, besides the ordinary salts, soluble silicates, not altered by boiling, drying, or heat of 100° C. These waters attack crystal glass, leaving an incrustation, which resists weak acids; and they seem to be free to act in re-consolidating strata. Indeed, in the deep parts of the gravel deposits, we meet with masses of rock in which solution of the silicates in water is hourly going on; and we may follow

these solutions to the wells, and observe that sometimes depositions are formed on the surfaces of the rocks, over which they pass.

Vanadium exists in the water, which supplies the wells of the district of the drift, as a transparent, colourless solution of magnesian calcic, manganous, and ferrous silicates, phosphates, carbonates, and vanadates.

The deposit which forms in the boiling water resembles in composition the matter as taken from rocks by weak solvents, although some of these compounds remain dissolved in the water after it has been boiled.

Detection of vanadium as oxide is easily and at once effected, by dissolving the deposit formed from boiling water, by means of diluted nitric or sulphuric hydrate. In this solution, the addition of a slight excess of ammoniac hydrate, and a moment after a considerable excess of ammoniac carbonate, insures the reduction of any vanadic compound, by the manganous and ferrous oxides, and separation of other compounds than magnesian oxide and the blue vanadous oxide, which appears in solution of a rich blue colour. In a nearly closed vessel, a bright strip of zinc will withdraw vanadous oxide from the blue solution, at first as a thin bronze coating, then after a black crust.

I believe this is the first discovery of vanadic compounds in water. Before announcing it, every source of error has been scanned; and the labour of connecting the compounds with the rocks where they originate has been performed, as necessary to completeness, in the evidence.

Manganous salts have been observed in waters where humic acid has acted on rocks containing manganous carbonate, and the existence of a water of this kind is known to me; but it must be considered quite apart in composition from a water in which soluble silicates include manganous silicate as part of a compound possessing novel characters.

In concluding this brief account of results proving the existence of phosphates and vanadic compounds in the cementing material of the most common rocks, I wish it to be considered as only introductory to a wide field of interesting research.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.*

By H. CARRINGTON BOLTON.

To study a subject advantageously and satisfactorily, the first requirement is a knowledge of the literature on that subject; in this belief we have compiled a catalogue of works on the history of Chemistry, for our own use and that of those who may be interested in the origin and development of this science. So far as we know, no bibliography of the kind exists, and as the materials for such a list are widely scattered the difficulty incurred is not inconsiderable. In the following catalogue we lay no claim to completeness, but desire that it should be regarded rather as an outline to be filled up by others having greater bibliographical experience and larger facilities for research.

This bibliography is confined to independent works; the numerous essays relating to the history of specific branches of chemical science, widely disseminated throughout periodical literature, are not included; we have inserted, however, the few catalogues of chemical books, which, though not embraced by the title of this compilation, are too important adjuncts in the history of chemistry to be omitted.

Nearly all encyclopædias and dictionaries of science contain articles on chemistry from a historical point of view, under the word "alchemy;" references to these would needlessly expand this bibliography, and have been omitted. We may here mention, as noteworthy, the

* From the *Annals of the Lyceum of Natural History, N. Y.*, vol. x.

article on alchemy in the "Encyclopédie Méthodique," Paris, 1792; in the "Allgemeine Encyclopædie der Wissenschaft und Künste," by J. S. Ersch und J. G. Gruber, Leipzig, 1818; in Rees's "Cyclopedia, or Universal Dictionary of Arts," Edinburgh, 1819; and in the "Handwörterbuch der reinen und angewandten Chemie," of Liebig, Poggendorff, and Wöhler, Braunschweig, 1857.

If undue consideration appears to be given to the history of alchemy as distinguished from chemistry proper, our readers will bear in mind that the early literature of chemistry is almost wholly devoted to the hermetic art. Alchemy is sometimes regarded as the dishonourable parent of a noble offspring, and has been sarcastically defined as: *Ars sine arte, cujus principium est mentiri, medium laborare, finis mendicare*; "an art without art, originating in falsehood and proceeding through labour to beggary. We agree, rather, with the British historian of chemistry, who remarks that, "Alchemy, or the art of making gold, furnishes too curious a portion of the aberrations of the human intellect to be passed over in silence," and we confess to a partiality for the study of the vagaries of the gold-makers, and to finding a fascination in tracking their mysterious footsteps.

Finally, a word of apology with regard to the annotations. In order to make the bibliography instructive and somewhat more readable than such compilations usually are, we have ventured to add brief remarks in connection with the less known publications, giving some account of the author and the nature of his work. In expressing an opinion with regard to the merits of a work we disclaim any intention of assuming the position of a standard in criticism, but we believe that the opinion of an individual may be of some value, even though the views taken are diametrically opposed to the judgment of others. We have an honourable precedent, moreover, in the "Bibliotheca Bibliographica" of that learned bibliographer, Julius Petzholdt.

The works which follow are arranged in chronological order:—

HOGHELANDE, THEOBALD VAN. *Historiæ aliquot transmutationis metallicæ pro defensione alchymicæ contra hortium rabicm.* 8vo. Coloniae, 1604.

Schmieder remarks that Hoghelande was an important personage in the history of alchemy, for after experiencing serious doubts of the transmutation of metals he became a vigorous defender of the faith, and freely made his convictions known. This essay is a collection of marvellous tales concerning veritable (?) transmutations. A German translation also appeared under the title: "Beweis das die Alchymey oder Goldmacherkunst ein sonderbares Geschenk Gottes sei." 8vo. Leipzig, 1604.

CONRING, HERMANN. *De hermetica Ægyptiorum veterc et Paracelsica nova medicina.* 4to. Helmstadtii, 1648. (Second edition in 1669.)

Conring bitterly attacks the extreme antiquity assigned to alchemy, and provoked the reply by Borrichius, noticed below.

BOREL, PIERRE. [BORELLUS.] *Bibliotheca chimica, seu Catalogus Librorum Philosophicorum Hermeticorum.* Auctore Petro Borellio. Parisiis, 1654.

The first extensive catalogue of chemical books. Contains four thousand authors.

KIRCHER, ATHANASIUS. *De Origine Alchymicæ*; also *De Lapide Philosophorum.* In *Mundus Subterraneus*, Vol. II., Liber XI., Sectio I. et II. Folio. Amsterodami, 1665.

Athanasius Kircher, a celebrated historian, philosopher, mathematician, and physical philosopher, was born at Fulda, in 1601, and died at Rome in 1680. He filled the chairs of philosophy and oriental languages in the College of Wurtzburg and in the Jesuit's College at Avignon.

He was afterwards professor of mathematics in the Jesuit's College at Rome. Kircher was a man of "wide and varied, but ill-digested erudition, and a most voluminous writer." Although credulous to an absurd degree, in the dissertation "*De Origine Alchymicæ*," he violently attacks the alchemists and their pretended transmutations of the baser metals into gold. It is reprinted in Mangetus's "*Bibliotheca Chemica Curiosa*," where also replies to his attacks, by Clauder and by Blauenstein, are found.

COOPER, WILLIAM. *A Catalogue of Chymicall Books, in 3 Parts, collected by William Cooper.* 12mo. London, 1675.

BORRICHIVS, OLAUS. *Dissertatio de ortu et progressu Chemicæ.* 4to. Hafniae, 1668. (Reprinted in the *Bibl. Chem. curiosa* of Mangetus, Vol. I., No. 1).

The author of this celebrated treatise, the most frequently quoted by succeeding historians, was born at Borchon (whence his latinised name), Jutland, in 1626. He was Professor of Philosophy, Poetry, Chemistry, and Botany, at the University of Copenhagen, a fact which causes Rodwell to remark that, "either Professors were difficult to procure in the Kingdom of Denmark, or else Olaus Borrichius was an astounding genius." However this may be, he was certainly a man of amazing credulity, and allowing "the imaginative faculty due to his poetical temperament, to exert an undue influence over his sober judgment," he refers the origin of alchemy to the antediluvians, endeavours to prove that Hermes Trismegistus was a real personage, the inventor of all arts, and the father of alchemy. and that the Smaragdine Table was really found by the wife of Abraham, besides accepting the preposterous theories of his contemporaries concerning the elixir of life and the philosopher's stone. This dissertation was highly prized by the alchemists of his day on account of its earnest defence of their principles.

Its present value is solely that of a curious example of the extravagant credulity of a learned man. According to Wiegand, Borrichius's work may be accounted the first history of Chemistry (Alchemy).

MORHOF, DANIEL GEORGE. *De Transmutatione metallorum Epistola ad virum nobilissimum Jochem Lange-lotum.* 8vo. Hamburg, 1673. (Reprinted in Mangetus's *Bibl. Chem. curiosa*, Vol. I., No. 9; also appeared in German, under the title: "D. G. Morhof's Abhandlung vom Goldmachen." Baireuth, 1764).

Morhof, born 1639, died 1691, was Professor of History at Kiel. Schmieder calls him an unprejudiced historian.

BORRICHIVS, OLAUS. *Hermetis, Ægyptiorum et chemicorum sapientia ab Herm. Conringii animadversionibus vindicata.* 4to. Hafniae, 1674. (Reprinted in Mangetus's *Bibl. Chem. curiosa*, Vol. I., No. 2).

BORRICHIVS, OLAUS. *Conspectus scriptorum chemicorum.* 4to. Hamburg, 1697. (Reprinted in Mangetus's *Bibl. Chem. curiosa*, Vol. I., No. 2).

MANGET, JEAN JACQUES. [MANGETUS.] *Bibliotheca Chemica curiosa, seu rerum ad alchemiam pertinentium Thesaurus instructissimus.* * * * Genevæ. 2 vols. Folio. 1702.

A collection of one hundred and thirty-three rare tracts on alchemy are here reprinted. Contains many bibliographical notes.

ROTH SCHOLTZ, FRIEDRICH. *Bibliotheca Chemica; h. e. Collectio Auctorum fere omnium qui de naturæ arcanis, re metallica et minerali * * hermetice scripserunt.* * * * 5 parts. 8vo. Norimbergæ, 1725—33.

The work of a Nuremberg bookseller well versed in literature. Contains the greater part of the work of Borel, which had already become scarce. Is, however, incomplete, extending only to the letter H.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—Dr. Campbell Brown explains in his letter (*vide* CHEMICAL NEWS, vol. xxxii., p. 28) that when he wrote his paper on "The Minimum of Solids in Milk," his object was *not* to controvert any of my statements, but that in writing the letter his object is to controvert my statements. And it was not without reason that the learned Doctor offered an explanation, for when the Doctor wrote in the abstract (*vide* CHEMICAL NEWS, vol. xxxi., p. 266) he wrote:—

"The following three samples are the poorest authentic samples out of three or four hundred which I have examined;" and after detailing certain particulars relative to the date, &c., of these three samples of milk, he gave the analyses of them as follows:—

| | Total Solids. | Cream. Per Cent. | Fat. | Solids not Fat. |
|-----------|---------------|------------------|------|-----------------|
| No. 1. .. | 11.10 | under 8 | 2.16 | 8.94 |
| No. 2. .. | 11.36 | about 9 | 2.41 | 8.95 |
| No. 3. .. | 11.55 | — | 2.74 | 8.81 |

But when the Doctor writes to controvert me, his analyses (*vide* CHEMICAL NEWS, vol. xxxii., p. 28) are as follows:—

| | Total Solids. | Fat. | Solids not Fat. |
|--|---------------|------|-----------------|
| No. 4. Average sample from several well-fed cows on a rich farm in Cheshire; <i>March</i> .. | 12.90 | 4.40 | 8.50 |
| No. 5. Country milk; <i>February</i> .. | 12.35 | 3.74 | 8.61 |
| No. 6. Cheshire milk, stall fed; <i>January</i> | 12.46 | 4.00 | 8.46 |

I have italicised the dates of these milks in order to call attention to the circumstance that they were before the date of the paper on "The Minimum of Solids in Milk," and not in the interval between the Doctor's paper and his letter.

Having these analyses in his possession at the time of his writing the paper, why did he not publish them? I think I can give the real answer. I believe that he had no confidence in them when he wrote his paper; and when he tells us that instead of drying up 5 grms. of milk he is in the habit of drying up 40 or 50 grms., we cannot wonder at his getting anomalous results.—I am, &c.,

J. ALFRED WANKLYN.

117, Charlotte St., Fitzroy Square, W.
July 19, 1875.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—I have read with interest, as all chemists are likely to do, the article and letter in the CHEMICAL NEWS, vol. xxxii., p. 26, referring to Dr. Voelcker's celebrated lecture before the Farmer's Club. Shortly after its delivery I gave my reasons for doubting many of the statements made by the learned Doctor, but my criticisms were addressed to a journal in which the report of the lecture appeared.* The lecture in question contains such palpable errors that grave doubt must be thrown on the accuracy of the remaining conclusions.

Among other assertions capable of absolute disproof, Dr. Voelcker says—"Milk purposely watered yields only 5 to 6 per cent of cream, and has invariably a lower specific gravity than 1.025." Now, I make it a point to ascertain, with accuracy, the specific gravity of every milk which passes through my hands. The determination is usually made with a hydrometer, but occasionally with a bottle. The former has been carefully verified and found accurate. The temperature I employ is 15.5° C. (=60° F.). Ascertained in this way, the gravity of a considerable number of samples of adulterated milk has frequently

reached 1.027 to 1.029, and has rarely been less than 1.024 or 1.025. It may be asked how I know with certainty that such milk was adulterated? The reply is, that in the majority of cases the milkmen admitted having added water, and in others the other results of analysis were such as would suffice to convince anyone but Dr. Voelcker. Yet, according to the Professor, who believes that he has "had as much experience in the examination of milk as anybody in England," "within certain limits the specific gravity is the most trustworthy indicator of quality."

After making this statement, it is rather startling to find that Dr. Voelcker gives the figures 1.0295 and 1.0257 as the average densities of milk adulterated with 10 and 20 per cent of water respectively!* It appears, therefore, that Dr. Voelcker believes that milk-dealers "invariably" add more than 20 per cent of water when they adulterate milk, for how, otherwise, could he assert that "milk purposely watered has invariably a lower specific gravity than 1.025."

Taking the figures of Dr. Voelcker's table, it appears that milk containing 25 per cent of added water would have a gravity of 1.0245, which is very slightly different from 1.025, which he takes as his lower limit of density for genuine milk. Yet, in his evidence before the House of Commons Committee (Question 5512), Dr. Voelcker expressed an opinion quite incompatible with the above statement. "In the case which I alluded to, half a pint of water had been mixed with a pint and a half of milk, and you think that adulteration to that extent ought always to be detected?—With the greatest facility."

Dr. Voelcker also argues that the presence of an unusual amount of cream cannot lower the density of milk to the same extent as the addition of water, and immediately afterwards gives a table of results from which a diametrically opposite conclusion is deducible. Thus, taking the percentage of cream on the milk at 10 per cent, which Dr. Voelcker says is about the average, it appears from the table that the process of skimming raises the density from 1.0314 to 1.0337. It must therefore be conceded that the addition of 10 per cent of cream to the original milk should have an equal but opposite effect,—that is, should lower the gravity by 1.0337 less 1.0314, equal to 0.0023. Dr. Voelcker's table shows that the addition of 10 per cent of water instead of cream reduces the gravity from 1.0314 to 1.0295, a difference of only 0.0019 as against 0.0023 produced by cream.

Dr. Voelcker appears anxious to prove the truth of certain fanciful notions, and if his facts are in opposition to his hobbies, why "so much the worse for the facts."

Although Dr. Voelcker puts the average amount of cream at 10 per cent, he says that "Milk purposely watered yields only 5 to 6 per cent of cream." It is evident that, to effect this change, the adulteration would have to amount to 40 or 50 per cent.

Dr. Voelcker's analyses go to show that by half-starving the cows they can be made to give milk as much as 2 per cent poorer in solids than had ever been observed before, and the lecturer was careful to point out that "as the milch cows were kept entirely for the use of the College, there can be no doubt of the genuineness of the supply." Unless the process of milking was most carefully watched, and *completed*, I contend that the evidence of genuineness is such as ought not to be accepted, and that in the face of the anomalous results of analysis there is *prima facie* reason to believe that the samples were either taken from the first portion of the runnings or were actually watered. It

* Dr. Voelcker gives the following table, showing accurately the specific gravities, at 62° F., of milk before and after skimming, and of samples *purposely prepared* so as to contain different quantities of added water.

| | Before Skimming. | After Skimming. |
|---------------------------|------------------|-----------------|
| Pure milk | 1.0314 | 1.0337 |
| With 10 per cent water .. | 1.0295 | 1.0303 |
| With 20 per cent water .. | 1.0257 | 1.0265 |
| With 30 per cent water .. | 1.0233 | 1.0248 |
| With 40 per cent water .. | 1.0190 | 1.0208 |
| With 50 per cent water .. | 1.0163 | 1.0175 |

From the *Pharmaceutical Journal* for March, 14, 1874, p. 744.

* *Pharmaceutical Journal*, March 28, 1874, p. 788.

must be remembered that the experiments were made some dozen years ago, and, taken in conjunction with the general looseness of statement which characterises the lecture, it appears highly probable that the collection of the samples was made in an equally slovenly manner.

Dr. Dupré very truly observes that the analyses in question were made "at a time when milk analysis was certainly much less understood than it is now, and by means of methods of which we know nothing," and he calls "upon Prof. Voelcker to publish the exact methods by which his results have been obtained."

Leaving Dr. Voelcker to reply or not, at his discretion, it may not be uninteresting to notice the method of milk analysis in the new edition of Normandy's "Chemical Analysis," which was "kindly supplied for this work by its author, Dr. A. Voelcker, F.R.S. In this scheme it is recommended to weigh out 500 grains of milk (!), coagulate it with a few drops of acetic acid (!), evaporate to dryness on a water-bath, *scrape* the dry residue out of the dish, reduce it to a fine powder, and again dry at 212° F. The weight of this residue should be 55 to 60 grains. The casein is to be calculated from the ammonia yielded by combustion of a portion of the dry residue with soda-lime, while the fat is estimated in another portion by extraction with ether, the ash ascertained in the remainder by combustion, and milk sugar estimated by difference.

Having found so much fault with Dr. Voelcker's lecture I cannot in justice omit to express my entire accord with him in his remarks on those "chemists" who profess to determine the proportion of water to the second place of decimals, and who would make no allowance for the natural variations to which milk is undoubtedly subject.

Almost the only chemist who has published results in any way tending to corroborate those of Dr. Voelcker is Dr. Stevenson Macadam, who has given chemists the benefit of the results of an elaborate series of analyses of milk collected under the eyes of his own assistant. There appears to be no doubt of the genuine nature of the samples, and that they really represented the entire runnings of the cows; but, on the other hand, it must not be forgotten that the dealers had a direct and evident inducement, throughout the whole series of experiments, to reduce the quality of the milk to the lowest possible point, so that the results may be said to show the extreme limit to which it is possible to reduce the solids of milk. In fact, Dr. Macadam expressly states that an improvement in the food was followed by a corresponding improvement in the quality of the milk. Dr. Macadam's results, therefore, do not represent the average composition of milk, but the composition of milk taken under the most unfavourable conditions.

Under these circumstances, it is not surprising that Dr. Macadam obtained an average of only 7·8 per cent of cream, while even Dr. Voelcker admits 10 per cent to be a fair average. His "total solids" varied from 10·57 to 14·54 per cent, the average being 12·04 in 100 by weight of the milk.

The proportion of "solids not fat" found by Dr. Macadam varied from 8·74 to 11·23, with an average of 9·62 (!). In only three cases out of forty-four were the "solids not fat" below 9 per cent, the numbers in these cases being, respectively, 8·74, 8·85, and 8·94 in 100 by weight of the milk. The samples were not mixed, but represented the milk of individual cows.

Dr. Macadam estimated the fat by the *loss of weight* which ensued on treating the dry residue with ether. His results are much lower than those of most chemists, but, taken in conjunction with the low yield of cream, must be regarded as fairly representing the fat in the samples. His lowest result (1·56), however, is undoubtedly erroneous, as I shall be happy to show if desired.

According to the results of Dr. Campbell Brown, published in the CHEMICAL NEWS, vol. xxxi., p. 266, the poorest specimens of genuine milk out of upwards of three hundred samples contained fully 11 per cent of total solids, the three poorest samples yielding 8·81, 8·94, and

8·95, respectively, from 100 parts, by weight, of milk. These milks were taken under exceedingly disadvantageous circumstances, so that they may be considered as fairly representing the poorest genuine milk possible. Yet Dr. Voelcker's paper contains analyses of milk which show 9·3 and 9·7 of total solids, with 7·51 and 6·71 of "solids not fat."

Even with these disadvantageous figures, Dr. Voelcker's average results for the year (excluding the favourable month of August, of which we have no record) show the milk to have contained a mean amount of 9·18 of solids not fat, and 12·27 of total solids.

How, in the face of his own analyses, Dr. Voelcker could give the following reply before the Committee is for him to explain:—

"Question 5513.—What is the greatest variation in the milk solids which you have found?—The greatest variation which I have found is, in round numbers, from 10 to 14. In an exceptional case, perhaps, I may have found even more than 14, but it is quite an exceptional case; but, generally speaking, I should say the usual variations are from 10 to 12 in good wholesome milk.

It appears, therefore, that the proportion of "solids not fat" is almost invariably over 9 per cent, the few authenticated samples in which less than that amount has been found having been taken from individual cows under extremely disadvantageous circumstances, and even then the proportion was only a trifle under 9 per cent. The *limit* of solids not fat adopted by the Society of Public Analysts may therefore be taken as fairly representing the lowest quality of milk ever yielded by a dairy, though individual cows occasionally give a milk slightly under.

The average proportion of "solids not fat" is of course sensibly higher, and analysts would be likely to avoid annoyance if in future they would certify samples of milk as being adulterated with a certain quantity of water if originally of average quality, and so much less water if of the poorest quality. Thus, if in the case at Greenwich reported on page 7, in which the solids not fat amounted to only 7·92, Mr. Wigner had reported the milk to contain 15 per cent of added water if the milk were originally of average quality, and 12 per cent if of the poorest quality known, a conviction would doubtless have ensued, and the magistrate would have been convinced that the analyst had not lost sight of the natural variations in the composition of milk.

There is no doubt there has been a tendency to interpret the results of milk analyses too rigidly, and all of us must cordially acquiesce in Dr. Campbell Brown's recommendation to be guided by the special circumstances of each case, and rather allow some who add a small quantity of water to rich milk to go unpunished, than one innocent person to be unjustly fined.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, July 17, 1875.

NOTICES OF BOOKS.

On the Nature of the Elements of Chemistry. By J. A. GROSHANS. Harlem: Les Héritiers Loosjes.

FROM this work we extract the following passages:—

"C, H, and O appear to be the only simple bodies; each atom of these substances counts for a single unity; all the other elements count several unities in their atom. I have been able to extend my observations and my calculations to more than 20 elements besides C, H, and O. This is not the only point of view under which C, H, and O form a group distinct from the other elements; they are sometimes, conjointly with nitrogen, called the organic elements. M. Littré, in his work "La Science," observes that life does not belong indifferently to every kind of matter; but that it has a certain elective virtue, and that its relations are essentially with carbon, hydro-

gen, oxygen, and nitrogen. There would seem, then, to exist some link between nitrogen and C, H, and O. Without wishing to draw any premature conclusion, it may be permissible to observe simply that the atomic weight of nitrogen is 14, that it corresponds to three atoms, and that these same attributes are those of CH_2 .

There was a time, we know, when eminent chemists were inclined to consider nitrogen as a compound body. At present, and for a considerable time, there has been a general return to the opinion that nitrogen should be regarded as a simple body by the same title as the other elements; however, as the real simplicity of these latter is now itself brought into question, it becomes necessary to revise the case of nitrogen.

It results, with complete evidence, from my observations and calculations, that nitrogen cannot be a simple body, but that it contains three atoms of simple bodies unknown. I purpose to demonstrate this double assertion by several independent methods."

Monthly Report of the Department of Agriculture for November and December, 1874. Washington: Government Printing Office.

THIS useful "blue book"—as we should call it in England—contains the statistics of the principal crops as produced in the United States, together with entomological, chemical, botanical, and microscopic memoranda of agricultural interest. Mr. McMurtrie, chemist to the department, has been investigating the application of arsenical compounds for the destruction of the Colorado beetle on potatoes. His experiments show that arsenic is not assimilated by vegetation. On this point—of considerable public importance, if we remember that the sulphuric acid used in manure-making contains arsenical compounds—his researches agree with those of Messrs. Ogston and Daubeney and clash with those of E. W. Davy. In many parts of the American Union the farmers suffer greatly from insect pests. As is the case in several European countries, the small insectivorous birds have been recklessly destroyed, a mistake which is bearing most unpleasant fruits.

Among the promiscuous paragraphs we find an "improvement" in the manufacture of cheese. The cream is removed from the milk, and oleo-margarine is added in its stead.

It appears that an attempt to introduce the cultivation of Upland cotton (Tennessee) in the province of Shantung, in China, has proved a failure. The pods never opened, and no fibre was obtained.

Outlines of Proximate Organic Analysis. By ALBERT B. PRESCOTT. New York: D. Van Nostrand.

PROXIMATE organic analysis may be described as a comparatively untrodden field. The best authorities at our disposal do little more than give us directions for detecting, isolating, and determining a few of the best-known organic acids and bases. But if it be desired to resolve an unknown body, animal or vegetable, into its immediate constituents, the operator has little to guide him save his own tact and experience. Under these circumstances we naturally welcome every chemist who attempts to supply so important a desideratum. Mr. Prescott arranges the substances of which he treats as solid fixed acids, solid volatile acids; liquid fixed acid; liquid volatile acids; fatty acids, liquid and solid; neutral substances; bases; glucosides; nitrogenous neutral bodies; carbohydrates and alcohols. Under each substance, he describes its characteristics, its separation from those bodies with which it is associated in nature, and, as far as known, its quantitative determination. From the table of contents we should judge that the author was more intent upon pharmaceutical than upon technological or physiological applications. The organic alkaloids

and the essential oils are elaborated with remarkable care, whilst on the other hand the weed colours, hæmatoxin, bresilin, carthamin, chlorophyll, &c., find no mention. The author, however, is far from professing to have furnished a complete and all-embracing system. He modestly admits that his work is "a fragmentary and very brief exponent of this part of analytical chemistry," and expresses the hope that "as a beginning, it may prove to be worth enough to afford an opportunity for its improvement hereafter." We trust that he will find ample opportunity to continue the important undertaking upon which he has entered.

CORRESPONDENCE.

ACTION OF THE GALVANIC CURRENT ON THE ORGANS OF SENSATION.

To the Editor of the Chemical News.

SIR,—It will give me pleasure to read Dr. T. L. Phipson's paper, when I can obtain the *Comptes Rendus*.

As, however, the independence of the galvanic taste and chemical action was not the "conclusion" drawn in my paper, but rather the minor premise, it is difficult to see how it can have been "anticipated."

I am glad to have Dr. Phipson's testimony to the fact.—I am, &c.,

W. H. STONE.

14, Dean's Yard, Westminster, S.W.,
July 19, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie,
May 3, 1875.

Compounds of Thallium with Alcohol-Radicals.—Dr. F. Hartwig.—The author, after some general remarks on the difficulty of pointing out the true place of thallium among the chemical elements, describes thallium-diethyl-chloride, $\text{Tl}(\text{C}_2\text{H}_5)_2\text{Cl}$, thallium diethyl iodide, sulphate, phosphate, nitrate, and acetate of thallium-diethyl, hydroxide of thallium-diethyl, and certain unsuccessful attempts to prepare thallium triethyl.

Apparatus for the Absorption of Ammonia.—J. V.—This apparatus, for use in the determination of nitrogen by the method of Will and Varrentrapp, is so contrived that the titration can be performed in it, without pouring out the liquid into a beaker.

On Trimethyl-benzol.—Paul Jannasch.—The author describes the preparation of trimethyl benzol from crystalline bromxylol, from dibromtoluol, and its formation as a by-product during the conversion of dibromxylol into durol.

Communications from the Chemical Laboratory at Greifswald.—These consist of a memoir on orthotoluidin sulph-acid, by Dr. F. A. Pagel; a paper on the conversion of metabromortho sulphotoluolic acid into orthocresol sulph-acid; and an essay on the nitro diazo-compound of paramido-orthosulphotoluolic acid, by the same author.

Isonylamid.—H. A. Kullhem.—The author considers this body as an isomer of amid as prepared in the ordinary manner.

Oxidation of the Oxyacids of the Fatty Series.—W. Markownikoff.—Not adapted for abstraction.

Remarks on (a) the Symbol for the So-called Rotatory Power of Substances.—O. Hesse.—Reserved for insertion in full.

Further Remarks on the Javanese Cinchona Calisaya.—O. Hesse.—The author maintains, in opposition to de Vry, that the species cultivated in Java is not the true *C. Calisaya*.

Test for Sulphate of Conchinin.—O. Hesse.—Take 0.5 gm. of the sulphate in question (1 part), digest with 10 c.c. of warm water (20 parts), till the temperature of the mixture has risen to 60°. Then add 0.5 gm (1 part) of pure iodide of potassium, stir repeatedly, let cool, and filter after the lapse of an hour. If the preparation was pure the filtrate is not rendered turbid by the addition of a few drops of ammonia. If a precipitate appears in the filtrate, it may consist of quinin, cinchonidin, and cinchonin.

Test for Sulphate of Chinidin.—O. Hesse.—To detect the presence of cinchonin and conchinin, as well as of totally worthless bodies in the sample, take 1 gm. of the sulphate and cover it in a test-glass with 7 c.c. of a mixture of 2 vols. chloroform, and 1 vol. alcohol of 97 per cent by volume. If the salt is pure, a clear solution results, but if inorganic salts are present they remain undissolved. Further, take 0.5 gm. sulphate, and digest it with 20 c.c. of water at 60°, and add 1.5 gm. salt of seignette, when a crystalline precipitate is formed. Filter after one hour and add a drop of ammonia to the filtrate. No turbidity should appear. If a precipitate is produced it may consist of cinchonin or conchinin.

Remarks on Dita Bark.—O. Hesse.—The author, in conjunction with Jul. Jobst, has been investigating this subject for some time, and has obtained several crystalline bodies, as well as traces of an amorphous alkaloid.

New Water Air-pump.—Arzberger and Zulkowsky.—This paper is useless without the accompanying illustration.

Improved Chloride of Calcium Tube.—This paper also requires an illustration.

On Amido Caprylic Acid.—E. Erlenmeyer and O. Sigel.—The authors describe the preparation of œnanthol and œnanthol-ammonia; the preparation, composition, and properties of amido caprylic acid and its salts, and speculate on its constitution.

Aniline Derivatives.—E. Mills.—The author suggests a procedure for the respective separation of the mono-, di-, and tri-derivatives of aniline which are formed in mixture.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 7, June 17, 1875.

Electric-Dynamic Machines.—A question of priority between M. Gramme and M. Lontin, into which the editor declines to enter.

Silvering Glass by means of Inverted Sugar, for Optical Purposes.—M. Adolphe Martin.—The author describes, at great length, certain improvements on his original process as given in *Les Mondes*, December 10, 1868.

Utilisation of Iron Pyrites.—It is well known that the sulphur necessary for the manufacture of sulphuric acid was formerly obtained from Sicily in the native state. The export duties having been considerably increased during the last 20 years the attempt was made to supersede it, and this was successfully accomplished by means of iron pyrites, a mineral which is met with in great abundance. The extraction of these pyrites is only profitable, however, where they occur in large masses. The residues of pyrites contain so large a proportion of iron (40 per cent) that in the single establishment of Meggen the loss thus occasioned amounts, annually, to more than a million and a quarter francs. These residues are, further, in such quantities that there is difficulty in finding room for them. Dr. Hofmann has succeeded in utilising them

on the large scale by the following process. The residues undergo a systematic washing, the temperature of the water being about 40° C. To the washings thus obtained salt is added in the proportion of one equivalent for each equivalent of sulphuric acid present in the liquid. The result is sulphate of soda, which is separated by cooling and crystallisation. This product has numerous industrial applications, especially in the glass trade and in the soda manufacture, and it is obtained in the present case in quantity sufficient to cover the cost of all the operations. The mother-liquors remaining after the sulphate of soda has been separated contain zinc chloride, salt, sulphates of iron and of zinc, and a further quantity of sulphate of soda. By concentration to 54° B., the various salts are deposited, with the exception of the zinc chloride, which may then be separated. It has several industrial applications, and is sold in Germany at 18½ francs per 100 kilos., and is chiefly used for preserving railway sleepers. Or it may be worked for metallic zinc, by being first treated with lime to convert it into zinc oxide. The residue from the last operation still contains the iron originally present in the pyrites, as also some sulphur. It is dried for some days in the open air and the bulk of it crumbles to a powder, though there remain also compact fragments. Here is the most interesting phase of Dr. Hofmann's results on the pyrites of Meggen. It appears that the pulverulent portion is almost completely free from sulphur, while the fragments still retain considerable quantities. A simple process of sifting suffices to separate the part free from sulphur, which is then ready for metallurgical treatment as an iron ore.

Bulletin de la Societe Chimique de Paris,
June 20, 1875.

Researches on Blood.—M. Armand Gautier.—A preliminary communication on the phenomena of coagulation. He remarks that the coagulation of blood is not the result of the life or the death of the blood. It depends neither on its carbonic acid nor on any of the gaseous elements, for the plasma may be dried and heated, even to 110°, without losing its property of spontaneous coagulability.

On Taurine.—M. R. Engel.—Taurine, generally regarded as isethionamid, is not, in reality, an amide, but a true glycocoll.

Action of Liquids, Culinary or Medicinal, upon Vessels of Tin Containing Lead.—M. Fordos.—An exhaustive enquiry into the circumstances under which lead in the form of plumbiferous tin used for lining saucepans, &c., and in the glaze of earthenware is attacked by wine, vinegar, solutions of common salt, &c. He concludes that lead in all forms should be excluded from cookery implements, and that its use should be prohibited under severe penalties.

Theory of Crystallisation and Solution.—M. Lecoq de Boisbaudran.—The author has recently announced that different isomorphs do not act in an identical manner upon a supersaturated solution, and that the different faces of one and the same crystal are not equally soluble. M. L. Pfaundler supposes that the fact of the unequal solubility of the surfaces of the same crystal may be explained by aid of the theory which he published some years ago, and that the author's results were indicated in such theory. M. L. de Boisbaudran, on the contrary, holds that the important hypotheses of M. Pfaundler are not merely not identical with the principles of which he has presented an experimental demonstration, but that they are incompatible with several of the facts observed. These hypotheses, which M. de Boisbaudran is far from wishing to reject as a whole, do not seem to him applicable to crystallisation or to solution. According to M. Pfaundler there must exist a continual exchange of molecules between a crystal and its mother-liquor. The exact point of saturation of the menstruum would correspond to the equality of the number of molecules

attaching themselves to the crystal in a given time, to the number of molecules, leaving the crystal and returning into solution. If we adopt this hypothesis, it is evident that even a very slight variation in the concentration of the liquid would alter the ratio between the numbers of molecules respectively entering and leaving the crystal, and would consequently induce an immediate increase or decrease of the weight of the crystal. This, however, does not take place, for a crystal, or a crystalline surface, may remain intact, without gain or loss in a liquid whose concentration varies within sensible limits. The author, therefore, concludes that the supposed exchange of molecules did not take place.

Central-Blatt für Agrikultur Chemie,
Heft 4, April, 1875.

Determination of Ozone in the Air.—Prof. Pettenkofer and Dr. Wolffhügel.—Hitherto we were in want of a method for determining ozone in atmospheric air with even approximate accuracy, the methods in use being ozonoscopic rather than ozonometric. Pettenkofer points out as a great defect that in exposing ozone papers to the air, no attention is paid to the volume of air which sweeps over them in a given time. Wolffhügel found that 1000 litres of air, taken in the open air, produced a reaction with paper dipped in iodide of potassium and starch. But the air of houses, even from uninhabited and well ventilated rooms, produced no reaction even when 10,000 to 12,000 litres were passed over the paper. Ozone was also found wanting in subterranean air.

Composition of Drain Waters.—Prof. Aug. Voelcker.—Taken from the *Journal of the Royal Agricultural Society of England*.

Heat-Conductivity of Different Soils.—Dr. A. von Littrow.—The petrographic and chemical composition of a soil has little influence in comparison with its mechanical texture. Lime and magnesia seem to diminish the conductivity. In a moist state all soils conduct water better than when dry.

Power of Plants to Exhaust the Water of Soils.—Dr. R. Heinrich.—Plants differ in their power of utilising the water of the soil. In peaty soils barley withered when the soil contained 47·7 per cent of moisture, and rye at 53·4. In a lime soil maize faded at 8·6, and horse beans at 12·7 per cent. The hygroscopic moisture of soils does not appear available for the growth of plants.

Utility of Certain Trade Residues as Manures.—Dr. P. Wagner.—An account of certain kinds of refuse sold as manures, such as butchers' offal, glue-makers' waste, &c.

Manurial Value of the Fæcal Matter Obtained on Liernur's System.—Prof. W. Gintl.—The average proportions are given as—Water, 92·5; nitrogen, 0·771; total ash, 1·624; phosphoric acid, 0·270; potash, 0·144; and soda, 0·396 per cent.

Town Sewage as Nutriment for Crops.—Prof. A. Müller and Prof. Dunkelberg.—An abstract of a paper read before the Congress of Naturalists at Breslau. The authors remark, very justly, that in Germany irrigation would frequently be impracticable during the winter, and that the same applies to "intermittent filtration."

Formation of Urea in the Organism.—Dr. W. von Knieriem.

Amount of Soda, Potash, and Chlorine in Milk Compared with that in other Articles of Diet, and that of the Entire Mammalian Organism.—G. Bunge.—An examination of the ash of the milk of various animals, taken in connection with their diet.

Milk During the time of Heat and of Calving.—Dr. G. Schröder.—At the former period nothing abnormal was observed. The first milk after calving did not coagulate on boiling, and showed no colostrum globules.

Amount of the Pressure of Sap in Plants.—W. S. Clarke.—From the *Transactions of the Massachusetts Agricultural College*.

Evaporation of Water from the Oat under Different Circumstances of Heat, Light, and Atmospheric Moisture, and on its Need of Nitrogen.—Dr. J. Fittbogen.—Not suitable for abstraction.

Certain Chemical Changes During the Germination of Pumpkin Seeds.—Prof. N. Laskovsky.—The amounts of carbonic acid developed depend on temperature, on the amount of dry matter in the seed, and on the duration of the germination. Elevation of temperature increases the evolution of carbonic acid. There appears to be no constant ratio between the carbonic acid and the hydrogen developed. The fat that disappears is in constant proportion to the cellulose and carbonic acid formed.

Chemical Composition of the Principal Sorts of Grapes Cultivated in the Province of Rome.—F. Sestini and G. del Torre.

Amount of Sugar, Acid, Potash, and Phosphoric Acid in 1000 Grapes at Different Periods of Ripeness.—Prof. C. Neubauer.

Investigation on the Nature of the Gelatinous Matter which separates from the Juice of Beet-Root.—Prof. C. Scheibler.—The chief constituent is dextran—a gum which turns the plane of polarisation to the right three times more powerfully than cane-sugar. Its formula is $C_6H_{10}O_5$.

Analyses of Samples of Wine.—Ch. Mène.—Taken from *Comptes Rendus*, vol. lxxix., No. 2, p. 136.

New Method of Producing Bread.—M. Cécil.—The author makes bread of the entire grain, after removal of the outer layer, and effects a saving of 30 per cent. He steeps the grain in water, when the skins are removed by revolving cylinders.

Causes of Alcoholic Fermentation.—Prof. Adolf Mayer.—The author maintains his former view that alcoholic fermentation is identical with the metastasis of the yeast-fungus.

Influence of the Access of Air on Alcoholic Fermentation.—Prof. Adolf Mayer.—The author finds that in the yeast plant the direct respiration of oxygen has no perceptible influence in splitting up sugar into the known products of fermentation.

Behaviour of Alcohol Yeast in Media Devoid of Oxygen.—Prof. M. Traube.—Taken from the *Berichte der Deutschen Chemischen Gesellschaft*.

Influence of the Addition of Alcohol to Must upon the Progress of Fermentation.—Dr. A. Blankenhorn.—Fermentation ceases if alcohol is added to the fermenting liquid to the extent of 14 to 15 per cent of its volume.

TO CORRESPONDENTS.

*** Vol. XXXI. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxxii. commenced on July 2nd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

F.C.S.—We have made a careful reference, and find that Heft (January, 1875) of the *Central-Blatt für Agrikultur Chemie* contains all the articles named in the CHEMICAL NEWS for May 7, 1875. In Heft 1 there is no paper on the periodicity of hail.

ERRATA.—In the table, p. 26 of our last number, col. "Solids not Fat," line 2, for 10·34 read 10·32; line 6, for 8·88 read 8·94; line 13, for 9·98 read 9·08; line 14, for 8·56 read 8·59; line 15, for 8·10 read 8·06; for "The average of the whole of solids not fat is 9·18," read "is 9·15."

THE CHEMICAL NEWS.

VOL. XXXII. No. 818.

PRELIMINARY NOTICE OF FURTHER RESEARCHES ON THE PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES UNDER VARIED CONDITIONS OF PRESSURE AND TEMPERATURE.*

By Dr. ANDREWS, F.R.S.,
Vice-President of Queen's College, Belfast.

THE investigation to which this note refers has occupied me, with little intermission, since my former communication in 1869 to the Society, "On the Continuity of the Liquid and Gaseous States of Matter." It was undertaken chiefly to ascertain the modifications which the three great laws discovered respectively by Boyle, Gay-Lussac, and Dalton undergo when matter in the gaseous state is placed under physical conditions differing greatly from any hitherto within the reach of observation. It embraces a large number of experiments of precision, performed at different temperatures and at pressures ranging from 12 to nearly 300 atmospheres. The apparatus employed is, in all its essential parts, similar to that described in the paper referred to; and so perfectly did it act, that the readings of the cathetometer, at the highest pressures and temperatures employed, were made with the same ease and accuracy as if the object of the experiment had been merely to determine the tension of aqueous vapour in a barometer tube. In using it, the chief improvement I have made is in the method of ascertaining the original volumes of the gases before compression, which can now be known with much less labour and greater accuracy than by the method I formerly described. The lower ends of the glass tubes containing the gases dip into small mercurial reservoirs formed of thin glass tubes, which rest on ledges within the apparatus. This arrangement has prevented many failures in screwing up the apparatus, and has given more precision to the measurements. A great improvement has also been made in the method of preparing the leather-washers used in the packing for the fine screws, by means of which the pressure is obtained. It consists in saturating the leather with grease by heating it *in vacuo* under melted lard. In this way, the air enclosed within the pores of the leather is removed without the use of water, and a packing is obtained so perfect that it appears, as far as my experience goes, never to fail, provided it is used in a vessel filled with water. It is remarkable, however, that the same packing, when an apparatus specially constructed for the purpose of forged iron was filled with mercury, always yielded, even at a pressure of 40 atmospheres, in the course of a few days.

It is with regret that I am still obliged to give the pressures in atmospheres, as indicated by an air- or hydrogen-manometer, without attempting for the present to apply the corrections required to reduce them to true pressures. The only satisfactory method of obtaining these corrections would be to compare the indications of the manometer with those of a column of mercury of the requisite length; and this method, as is known, was employed by Arago and Dulong, and afterwards in his classical researches by Regnault, for pressures reaching nearly to 30 atmospheres. For this moderate pressure a column of mercury about 23 metres, or 75 feet, in length had to be employed. For pressures corresponding to 500 atmospheres, at which I have no difficulty in working with my apparatus, a mercurial column of the enormous height of 380 metres, or 1250 feet, would be required. Although the mechanical difficulties in the construction of a long tube for this pur-

pose are, perhaps, not insuperable, it could only be mounted in front of some rare mountain escarpment, where it would be practically impossible to conduct a long series of delicate experiments. About three years ago I had the honour of submitting to the Council of the Society a proposal for constructing an apparatus which would have enabled any pressure to be measured by the successive additions of the pressure of a column of mercury of a fixed length; and working drawings of the apparatus were prepared by Mr. J. Cumine, whose services I am glad to have again this opportunity of acknowledging. An unexpected difficulty, however, arose in consequence of the packing of the screws (as I have already stated) not holding when the leather was in contact with mercury instead of water, and the apparatus was not constructed. For two years the problem appeared, if not theoretically, to be practically impossible of solution; but I am glad now to be able to announce to the Society that another method, simpler in principle and free from the objections to which I have referred, has lately suggested itself to me, by means of which it will, I fully expect, be possible to determine the rate of compressibility of hydrogen or other gas by direct reference to the weight of a liquid column, or rather of a number of liquid columns, up to pressures of 500 or even 1000 atmospheres. For the present it must be understood that, in stating the following results, the pressures in atmospheres are deduced from the apparent compressibility, in some cases of air, in others of hydrogen gas, contained in capillary glass tubes.

In this notice I will only refer to the results of experiments upon carbonic acid gas when alone or when mixed with nitrogen. It is with carbonic acid, indeed, that I have hitherto chiefly worked, as it is singularly well adapted for experiment; and the properties it exhibits will doubtless, in their main features, be found to represent those of other gaseous bodies at corresponding temperatures below and above their critical points.

Liquefaction of Carbonic Acid Gas.—The following results have been obtained from a number of very careful experiments, and give, it is believed, the pressures, as measured by an air-manometer, at which carbonic acid liquefies for the temperatures stated:—

| Temperatures in Centigrade Degrees. | Pressure in Atmospheres. |
|--|-----------------------------|
| 0°00 | 35°04 |
| 5°45 | 40°44 |
| 11°45 | 47°04 |
| 16°92 | 53°77 |
| 22°22 | 61°13 |
| 25°39 | 65°78 |
| 28°30 | 70°39 |

I have been gratified to find that the two results (for 13°09° and 21°46°) recorded in my former paper are in close agreement with these later experiments. On the other hand, the pressures I have found are lower than those given by Regnault as the result of his elaborate investigation (*Mémoires de l'Académie des Sciences*, vol. xxvi., p. 618). The method employed by that distinguished physicist was not, however, fitted to give accurately the pressures at which carbonic acid gas liquefies. It gave, indeed, the pressures exercised by the liquid when contained in large quantity in a Thilorier's reservoir; but these pressures are always considerably in excess of the true pressures, in consequence of the unavoidable presence of a small quantity of compressed air, although the greatest precautions may have been taken in filling the apparatus. Even $\frac{1}{500}$ th part of air will exercise a serious disturbing influence when the reservoir contains a notable quantity of liquid.

Law of Boyle.—The large deviations in the case of carbonic acid at high pressures from this law appeared distinctly from several of the results given in my former paper. I have now finished a long series of experiments on its compressibility at the respective temperatures of 6°7°, 63°7°, and 100° C. The two latter temperatures were obtained by passing the vapours of pyroxylic spirit (methyl-alcohol) and of water into the rectangular case with plate-glass sides, in which the tube containing the carbonic acid is

* A Paper read before the Royal Society.

placed. The temperature of the vapour of the pyroxylic spirit was observed by an accurate thermometer, whose indications were corrected for the unequal expansion of the mercury: while that of the vapour of water was deduced from the pressure as given by the height of the barometer and a water-gauge attached to the apparatus. At the lower temperature (6.7°), the range of pressure which could be applied was limited by the occurrence of liquefaction; but at the higher temperatures, which were considerably above the critical point of carbonic acid, there was no limit of this kind, and the pressures were carried as far as 223 atmospheres. I have only given a few of the results; but they will be sufficient to show the general effects of the pressure. In the following tables p designates the pressure in atmospheres as given by the air-manometer, t' the temperature of the carbonic acid, ϵ the ratio of the volume of the carbonic acid under one atmosphere and at the temperature t' to its volume under the pressure p' and at the same temperature, and θ the volume to which one volume of carbonic acid gas measured at 0° and 760 millimetres is reduced at the pressure p and temperature t' :—

| Carbonic Acid at 6.7° . | | | |
|----------------------------------|--------------------|-------------------|------------|
| p . Atmospheres. | t' . Degrees. | ϵ . | θ . |
| 13.22 | 6.90 | $\frac{1}{14.36}$ | 0.07143 |
| 20.10 | 6.79 | $\frac{1}{23.01}$ | 0.04456 |
| 24.81 | 6.73 | $\frac{1}{29.60}$ | 0.03462 |
| 31.06 | 6.62 | $\frac{1}{39.57}$ | 0.02589 |
| 40.11 | 6.59 | $\frac{1}{58.40}$ | 0.01754 |

| Carbonic Acid at 63.7° . | | | |
|-----------------------------------|--------------------|--------------------|------------|
| p . Atmospheres. | t' . Degrees. | ϵ . | θ . |
| 16.96 | 63.97 | $\frac{1}{17.85}$ | 0.06931 |
| 54.33 | 63.57 | $\frac{1}{66.06}$ | 0.01871 |
| 106.88 | 63.75 | $\frac{1}{185.90}$ | 0.00665 |
| 145.54 | 63.70 | $\frac{1}{327.30}$ | 0.00378 |
| 222.92 | 63.82 | $\frac{1}{446.90}$ | 0.00277 |

| Carbonic Acid at 100° . | | | |
|----------------------------------|--------------------|--------------------|------------|
| p . Atmospheres. | t' . Degrees. | ϵ . | θ . |
| 16.80 | 100.38 | $\frac{1}{17.33}$ | 0.07914 |
| 53.81 | 100.33 | $\frac{1}{60.22}$ | 0.02278 |
| 105.69 | 100.37 | $\frac{1}{137.10}$ | 0.01001 |
| 145.44 | 99.46 | $\frac{1}{218.90}$ | 0.00625 |
| 223.57 | 99.44 | $\frac{1}{380.90}$ | 0.00359 |

These results fully confirm the conclusions which I formerly deduced from the behaviour of carbonic acid at 48° , viz., that while the curve representing its volume under different pressures approximates more nearly to that of a perfect gas as the temperature is higher, the contraction is nevertheless greater than it would be if the law of Boyle held good, at least for any temperature at which experiments have yet been made. From the foregoing experiments it appears that at 63.7° carbonic acid gas, under a pressure of 223 atmospheres, is reduced to $\frac{1}{447}$ th of its

volume under one atmosphere, or to less than one-half the volume it ought to occupy if it were a perfect gas and contracted in conformity with Boyle's law. Even at 100° the contraction under the same pressure amounts to $\frac{1}{381}$ part of the whole. From these observations we may infer, by analogy, that the critical points of the greater number of the gases not hitherto liquefied are probably far below the lowest temperatures hitherto attained, and that they are not likely to be seen, either as liquids or solids, till much lower temperatures even than those produced by liquid nitrous oxide are reached.

(To be continued).

ON THE USE OF POTASSIUM FERRO- AND FERRI-CYANIDE FOR THE DETECTION OF NICKEL AND COBALT.

By R. H. DAVIES, F.C.S.,

Demonstrator of Chemistry in the Laboratory of the Pharmaceutical Society.

IN a former number of the CHEMICAL NEWS (vol. xxiii., p. 290) Mr. Allen has advocated the employment of ferricyanide of potassium for the above purpose, and has detailed the method he adopts for the qualitative analysis of solutions which might contain nickel and cobalt.

Briefly, the method is as follows:—Ferricyanide of potassium is added to the solution, which has previously been treated with ammonium chloride and ammonia in excess. A red colouration indicates cobalt. Upon then boiling this liquid, a copper-coloured precipitate is deposited, which contains the nickel.

No objection can be urged against this process, except that, if the amount of nickel present be very small, a precipitate is only obtained after boiling the liquid for some minutes.

By using ferrocyanide of potassium after the addition of ferricyanide, this is rendered unnecessary, and I should propose the following as a modification of the above test. When only the two metals, nickel and cobalt, are present in solution, add ammonia until the precipitated hydrates are re-dissolved (ammonium chloride does not appear to be essential), then potassium ferricyanide. If the amount of cobalt is large, a reddish brown precipitate of cobalt ferricyanide will occur. This is soluble in excess of the ferricyanide solution, which must then be added until it has disappeared, and a deep red-brown liquid results. It is, perhaps, hardly necessary to state that, if only an exceedingly small quantity of cobalt be present, no precipitate, but a colouration merely (in itself evidence of this metal), will be observed upon the addition of ferricyanide. Ferrocyanide of potassium must now be added, and here, again, a precipitate of nickel ferrocyanide will occur if much nickel salt be present. If the liquid remain clear, add hydrochloric acid drop by drop, noting the effect. A precipitate (yellowish white) upon the addition of from 6 to 12 drops, while the colour due to cobalt ferricyanide remains unchanged and the liquid is still strongly alkaline, indicates nickel, whilst if none of this element be present no apparent effect will be produced by the hydrochloric acid, until suddenly, on neutralisation, the colour disappears, and a yellowish white precipitate of cobalt ferrocyanide is thrown down.

I regret that I have not yet succeeded in utilising this reaction for quantitative work. Whenever cobalt is present as well as nickel, the precipitate at first obtained (which I judge to be nickel ferrocyanide) contains some cobalt, and the amount of the latter appears to vary with the varying proportions of the mixture.

I have lately been trying the effect of omitting the ferricyanide altogether, and employing ferrocyanide to indicate both metals. When this reagent is added to a dilute solution of cobalt salt in ammonia, the light yellowish liquid changes rapidly with heat, more slowly at ordinary

temperatures, and assumes a colour very similar to that obtained immediately upon adding ferricyanide of potassium to a solution of the same strength. If hydrochloric acid be now added, the same result will be obtained as in the former instance; very little effect, apparently, before neutralisation if cobalt only is present; a precipitate long before neutralisation if nickel accompanies cobalt.

There seems little to choose between the two methods. On the score of accuracy, either leaves very little to be desired; perhaps, for expedition's sake, the latter is preferable.

Mr. Skey has told us that, by using ferricyanide of potassium, 1 part of cobalt in 60,000 of water may be easily detected. I have detected 1 part of nickel in 10,000 of water by the former of the two processes, in which ferrocyanide is used.

When ferrocyanide of potassium is added to a solution of nickel salt, so diluted that the amount of ferrocyanide of nickel formed does not render the liquid perceptibly turbid, upon boiling the liquid assumes a light clear green tint, very easily observed by looking through the bulk of liquid, as in the operation of Nesslerising. This colour differs very much from the yellowish colour obtained upon boiling a test-tube full of water, to which two or three drops of solution of potassium ferrocyanide have been added, and from any tint that I have been able to get with mixtures of ferrocyanide with very dilute ferric and ferrous solutions; and it is even more evident after the nickel compound has been freed as far as possible from impurities. I am inclined to attribute it to the nickel salt itself, a conclusion I have been some time in arriving at.

One part of nickel salt in 100,000 yields a distinctly green solution upon boiling after adding a drop or two of ferrocyanide of potassium.

In conclusion, the main object of this paper is to show that—(1) Since ferrocyanides of Co and Ni are both soluble in liquids strongly alkaline with ammonia; and (2) since the solubility of the former salt in liquids not so strongly alkaline is greater than that of the latter,—we have a means of approximately separating the two metals, sufficient for qualitative analysis, by the gradual addition of acid to the solution of their ferrocyanides in ammonia.

I have to thank Mr. W. M. Paterson for the aid he has so kindly afforded me in working out some of the details for the most advantageous application of the test.

17, Bloomsbury Square, W.C.

IMPLEMENTS FOR FILTRATION.*

By P. CASAMAJOR.

(Concluded from page 34).

II.—New Funnels for Filtering under Pressure.

Although the advantages resulting from the use of filter-pumps are obvious, these useful implements are comparatively little used. This circumstance cannot be attributed wholly to the difficulty or expense attending their construction, for many laboratories are provided with them in which they remain idle because operators prefer to work without them. The chief objection to their use is that, if any portion of a paper filter is not properly supported, it will be inevitably torn as soon as a vacuum is formed under it. This accident happens so often that most chemists are unwilling to risk the loss of an analysis for the sake of saving time in filtering.

The plan generally adopted for preventing the tearing of filters is to use a perforated cone made of platinum-foil, which is placed so as to support the apex of the paper filter. For the sake of greater safety, instead of a single filter, two are used, one lying within the other. The portion of the filters above the platinum cone is pressed tightly against the sides of the funnel. This is

the plan of Prof. Bunsen. It generally gives satisfactory results when great care is taken; but sometimes, even after giving the greatest attention to the security of the paper filter, it becomes torn and the precipitate goes through. Often, when the liquid has passed through clear, have I found part of the precipitate between the inner and outer filter.

After trying many ways of overcoming this difficulty, I was fortunate enough to find a plan which answers so perfectly that I am able to say that torn filters and lost precipitates are things that trouble me no more. It is my purpose to describe this plan here, and, as it was suggested to me by a process of filtration published by Dr. H. Carmichael,* I propose to give a brief account of Dr. Carmichael's process, and afterwards to give a description of my plan.

In the process proposed by Dr. Carmichael, which may be designated *upward filtration*, a liquid holding a precipitate in suspension, instead of being filtered by placing it in a paper cone held in a conical glass funnel, is poured into a platinum dish, and the liquid is separated from the precipitate by the agency of a small paper disk held against a perforated surface belonging to a vessel the interior of which communicates with an aspirator. While one side of the paper disk adheres to the perforated surface, the other side is in contact with the contents of the platinum dish, so that when the pressure is reduced in the vessel the liquid passes through the paper, leaving the precipitate in the dish.

In Dr. Carmichael's arrangement the vessel is a bulb blown at the end of a glass tube, and the surface against which the paper adheres is a part of the bulb which has been flattened and riddled with holes.

This arrangement solves completely the problem of supporting the whole surface of the paper filter, as this is a flat disk resting on a flat perforated surface. There is, however, a serious drawback to using this arrangement, which is that the construction of its most important element is—to say the least—a very difficult matter. To obtain the perforated surface the following directions are given in Crookes's "Select Methods of Chemical Analysis," p. 431:—"Take a glass tube having an inner bore of 2 m.m.; blow at one end a thick bulb; flatten the bulb at the bottom; keep this bulb so hot that the glass is only slightly softened, and, while in this condition, make holes in it by means of a white-hot steel wire."

After trying several plans to accomplish the same result in a more satisfactory manner, I had the good fortune to find the following solution:—It consists in the simple expedient of supporting the circular paper filter by a thin perforated metallic disc, applied to the inside of the funnel. The filter is to be made somewhat larger than the metallic disc, so that its edges may rest on the funnel; and the funnel itself must have such a shape that the angle between the metallic plate and the funnel be very obtuse (about 165°). The deformation of the paper filter in that case is not perceptible; but if the angle should be too small the edges of the paper filter will not lie flat on the funnel, and it will not be possible to have a tight joint.

In Figs. 3 and 4 are represented the funnels I have adopted: in Fig. 3 is represented the funnel for filtering in the manner recommended by Dr. Carmichael; and in Fig. 4 the one for ordinary downward filtration, which form I use most frequently. With this funnel satisfactory results may be obtained even without a filter-pump, as will be presently shown.

The funnel represented in Fig. 3 resembles somewhat a Plattnerian blowpipe mouth-piece. To make use of it we lay one or two circular paper filters on a perforated metallic disc, having a somewhat smaller diameter. If now the funnel is placed in communication with the vacuum formed by a filter-pump, and the paper filter is moistened, it will adhere to the funnel when applied against its interior surface. In applying the filter and

* Communicated by the Author.

* See "Select Methods of Chemical Analysis," by William Crookes, F.R.S., p. 429.

metallic disc care should be taken that the disk be placed inside and the filter outward. I have sought to indicate the metallic disc by a line of coarse dots, while the paper filter is represented by a fine dotted line. Platinum is the best material for making the perforated discs, which may

Fig. 3.

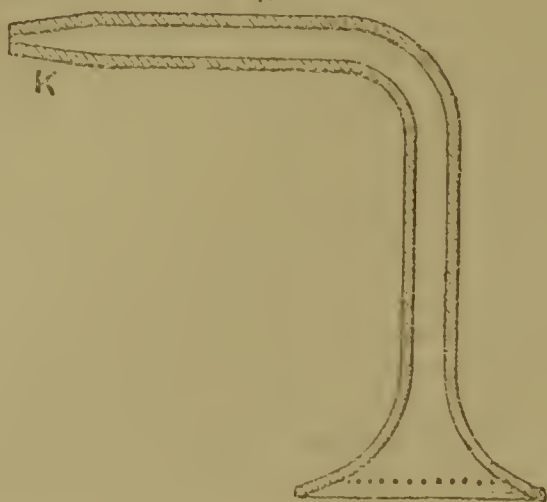
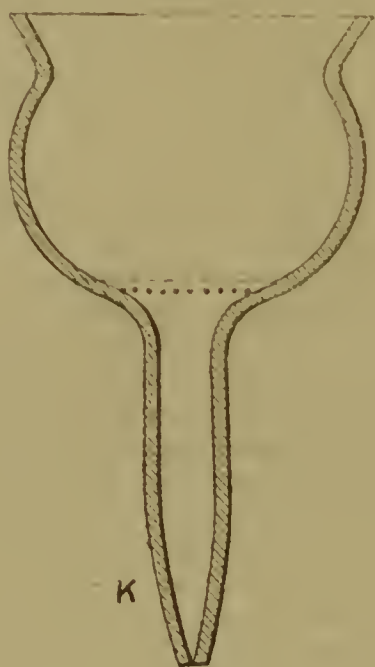


Fig. 4.



be easily riddled with holes with a coarse needle. For many purposes perforated tin plate and brass answer very well. As to their sizes, I may say that those I use have diameters of 1 inch to 1½. The paper filters are ¼ inch larger. With these small surfaces the results obtained are much superior to those given by conical filters made from discs of 6 inches diameter.

After a precipitate has been thoroughly drained and washed, it may be allowed to dry by continuing the action of the filter-pump for some time. After stopping the action of the filter-pump, if the funnel be slightly shaken, the paper filter and perforated metal plate will remain in the platinum dish, while a small portion of the precipitate will still adhere to the funnel. The metallic disc, lying on top of the precipitate in the dish, is very easily removed by forceps. To remove the small portion of precipitate adhering to the funnel, it should be dried by placing the funnel in a porcelain dish and heating slightly. When dry it may be entirely removed from the funnel with a feather, and added to the contents of the platinum dish.

With some precipitates there exists a remarkable peculiarity, to which it is not useless to call attention to show how the trouble caused by it may be avoided. An instance of a substance showing the peculiarity in question is the fine powder obtained when bone-black has been treated with hydrochloric acid so as to dissolve the calcic salts. If this fine carbon and the liquid accompanying it are thrown in the platinum dish, the liquid will be taken up by the aspirator as long as enough water remains

with the finely divided carbon. When most of the water has been separated the carbon becomes quite firm, and adheres like a cement to the filter, so that no amount of suction can free the tube *h* from the water it holds. The tube may be drained, however, by inserting a very fine needle under the paper disk after the precipitate has become quite firm: this opens a small air-passage, and the liquid in the tube is immediately aspirated.

Funnel for Filtering Downwards.—This funnel is represented in Fig. 4. The metallic disc is represented by a line of coarse dots, while the paper filter is shown by a fine dotted line. The shape of the funnel, in the portion near the filter, is the only essential part. The general form of it has been adopted for the greater convenience of the glass-blower. The end *k* is made tapering, so as to connect and disconnect with the aspirator by insertion in a rubber tube. The filtering disc is placed in this funnel as in the one represented in Fig. 3. If two superposed filters are used instead of a single thickness the filtration will be quite as rapid, while the safety will be greater. Before pouring the liquid in the funnel it is always advisable, for greater safety, to press down the margin of the filter, so as to insure the closing up of any minute opening left by a fold in the paper. This recommendation applies equally to filters used with the funnel represented in Fig. 3.

The funnel represented in Fig. 4 may be used advantageously without the filter-pump, by attaching to the end *k* a vertical glass tube of small diameter. The contraction at the end *k* in this case becomes very useful, by allowing the filtered solution to collect before descending in the vertical tube so as to fill the tube. In this manner there is formed a vertical column which creates an aspiration, and gives quicker filtration than can be had with a common conical funnel. The washing of the precipitate is also more thorough, because all the water placed in the funnel has to go through the precipitate, while in the ordinary conical funnel a part passes off above the precipitate. For the same reason it is obvious that this funnel may be used as a percolator to exhaust porous materials of their soluble parts. The additional length obtained by connecting with a vertical tube would not be of any utility with a conical funnel, unless a platinum cone was used to support the apex of the filter, and at the same time the rest of its surface was pressed down tightly on the glass; otherwise the air, entering freely around the filter, would not allow a column of liquid to form and to produce suction.

With the funnel represented in Fig. 4 very good results are obtained with tubes only 15 inches long. Longer tubes act with greater energy, but are inconvenient to use.

471, Lafayette Avenue, Brooklyn, N.Y.,
May 6, 1875.

NOTE ON SALICYLIC ACID.

By EDWARD R. SQUIBB, M.D., Brooklyn, N.Y.

THIS substance, long known as a rare and curious chemical derived from the vegetable kingdom, has lately been brought into prominent notice, chiefly in Germany, from its relation to those changes which are commonly known, and best understood as fermentations, to which class or kind of changes so many diseases and pathological conditions are now pretty well known to belong.

The writer knows far too little of the subject and its relations to attempt an accurate or exhaustive paper upon it, and the object of this note is simply to call attention to it, that it may be read up in the current literature—to give a brief outline of its bibliography, that reference may be made in regard to its history—and to offer some thoughts in regard to its sphere in medicine.

Salicin is a glucoside, or neutral vegetable principle

discovered by Leroux* in 1830, in the bark of some species of willow, *Salix*, whence its name. It was afterwards found in various species of poplar,† and in other trees and plants. Salicin was chiefly investigated by Piria‡ who gave an elaborate account of its derivatives, and among these, of salicylic acid. Early in its history the acid was prepared by Löwig and Weidmann§ from the flowers of *Spiræa ulmaria*; and later, a research by Prof. Procter,|| of Philadelphia, showed that our oil of wintergreen, *Gaultheria procumbens*, was really a salicylous ether; and from this source salicylic acid was obtained by Cahours.¶ Gerhardt,** Ettling,†† and others contributed to the researches by which the properties and reactions of salicylic acid were accurately determined and its composition fixed; but as yet it was but a chemical curiosity whose potential possibilities were quite unknown. It still belonged to that class of substances which had simply consumed a large amount of patient labour, and in relation to which the rigid utilitarian asked Michael Faraday "What is the use of such things?" and received for reply the answer, "What is the use of a baby?"

The physiological and pathological effects of salicin though imperfectly investigated, seem to have gradually and slowly directed attention to those of its derivatives, and occasional paragraphs have appeared in current scientific literature, from time to time, upon salicylic acid for some years past. But only within a year or two—and the writer regrets that he does not know by whom first—German writers have alluded to its peculiar and powerful effects as an antiferment, and antiseptic. As its peculiar powers were recognised, and its importance became possible and probable, the sources from which it had been obtained as a chemical curiosity became impracticable, in consequence of the small quantity which could be obtained from them, and the great cost in material and labour.

The next step in the progress of salicylic acid toward practical utility affords an excellent illustration of the progress in chemical knowledge made of late years.

The modern chemist appears to know, within certain limits, the combinations of the elements in organic substances very much as he knows the axes of crystals, and hence deduces their planes of cleavage. That is he knows how they will split up under given conditions, and what new arrangements of their elements are possible, or even practicable. And further, he knows by pure reasoning upon facts, what new elements to introduce between the molecules of one combination to split it up by a new set of affinities into new combinations never before seen or reached, and which would have remained long unknown under the mere empirical researches of the older chemistry. The peculiar properties and reactions of salicylic acid as an antiferment producing a demand for it, the German chemists, Kolbe†† and Lautemann, sought for an organic compound which from its elementary composition might be split or dissociated into the desired new compound salicylic acid. This substance, whose molecule might be broken up, they found in phenol, or the so-called carbolic acid, and it is a very curious circumstance—purely accidental so far as this writer knows—that a substance of well and long established character as an antiferment, should have offered to these chemists a molecular constitution so well adapted to be broken up into a still more powerful antiferment; for there is no relation whatever, either in com-

position, or chemical, or physical properties between carbolic acid and salicylic acid, except in their effects as antiferments, and the two may, so far as present knowledge extends, accomplish these effects by similar, or by altogether different reactions. The agent which the German chemists selected to resolve the molecule of phenol into other molecules, one of which should be salicylic acid, was dry carbonic acid or carbonic anhydride, as it is called in the new chemistry. Thus from the action of carbonic acid on carbolic acid, salicylic acid is produced; a process which is about as far from the original willow tree as a source of the acid as can well be imagined, and yet a process which is as much the result of human knowledge based upon human research as that by which Le Verrier and Adams discovered the planet Neptune. It appears that where phenol or cresol, and perhaps others of the class of phenols, are combined with an alkali metal such as sodium or potassium, thus forming phenol-sodium (often called phenate of soda) for example, and well dried carbonic anhydride is passed through the dry powder of phenol-sodium heated to 100° to 250° C.=212° to 482° F., the reaction occurs which produces salicylate of sodium and other compounds. The salicylate of sodium thus formed is dissolved in water and decomposed by hydrochloric acid, which, uniting with the sodium by superior affinity, sets free the salicylic acid in the form of small crystals. These crystals are washed and re-crystallised from a hot solution, and when dried form a crystalline powder of a light brown colour, somewhat resembling in colour the powder of pale cinchona bark. This is unbleached salicylic acid, and is probably pure enough for almost all, if not for all, the purposes to which the acid is at present applied to practical uses. The small proportion of colouring matter which it contains in this condition is held by it with great tenacity, and the further processes by which it may be obtained of various shades up to whiteness are so difficult, troublesome, and expensive, that they more than double the cost of production. This bleaching may be accomplished in various ways to a certain extent, but to get the acid quite white, Kolbe recommends that it be converted into an ether, and this ether be again decomposed. In the writer's practice no good plan of decolourising has yet been reached, and as the decolourising has not yet been shown to be necessary or very useful, no great attention has yet been given to it. The acid imported from Germany at very high prices is occasionally quite white; but most of that sold at the more moderate prices of 2 to 3 dollars per ounce is of various degrees of whiteness, up to a very light cream colour with a reddish tinge. These varying shades of colour seem to show that bleaching processes, more or less effective, have been used with all the acid yet imported into this country; while, so far as known, none has been made here until the writer lately undertook it. Hence the entirely natural, or entirely unbleached acid has not, so far as known, been yet used to any considerable extent; and it is a mere reasoning process based upon the quantity and qualities of the colouring matter in the well-made unbleached acid by which it is inferred that for most, if not for all of its present uses, this is as good as the more or less bleached product. If the well-made unbleached acid be found to subserve all the useful purposes to which the substance may be applicable, as is confidently expected by this writer; and if the substance should even in moderate degree realise the expectations of its importance in the arts, and in medicine, as indicated by the European authorities, the process of Kolbe will make it practically attainable in the necessary quantities at a far lower cost; whilst without some such process it would be of very limited use to mankind, whatever might be its powers. Whether bleached or unbleached, the acid is in minute broken acicular crystals, which give it the appearance of a granular powder, soft and smooth under the pestle or knife, but somewhat rough or resinous when rubbed between the fingers. This powder is odour-

* *Journ. de Chim. Med.*, vol. vi., p. 341.

† Braconnot, *Ann. Chim. Phys.*, vol. xlv., p. 296.

‡ Piria, I, *Compt. Rend.*, vol. vi., p. 388, and *Ann. Pharm.*, vol. xxx., p. 165.

§ *Journ. Pr. Chem.*, Bd. xix., s. 236.

|| *Amer. Journ. Pharm.*, vol. xiv., p. 211.

¶ *Compt. Rend.*, vol. xvi., p. 863.

** *N. Ann. Chim. Phys.*, vol. vii., p. 217.

†† *Ann. Pharm.*, vol. lxiii., p. 77.

‡‡ *Archiv. der Pharmacie* (3) vol. v., p. 445, from *Journ. fur Practische Chemie*, Bd. x., s. 89, and quoted in *Ding. Polytech. Journ.*, Bd. ccxiv., s. 132, and in *Pharm. Journ.*, third series, No. 231.

ess and nearly tasteless. It has, however, a sweetish and astringent after-taste with slight acidity in the fauces, but none in the mouth; and though tasteless, it leaves a disposition or inclination to expectorate, which continues for some time.

It is practically insoluble in cold water, but is very soluble in hot water; and the water of a hot solution retains when cold, in proportion to its coldness, from about 1 part in 250, to 1 part in 500 of the solution. The presence of various neutral salts in small proportion in the water render it far more soluble. Up to this time phosphate of sodium seems to have been chiefly used in Germany* to render it more soluble in water for medicinal purposes, and it is said that 3 parts of phosphate of sodium will render 1 part of the acid easily soluble in 50 parts of water. It is much more soluble in alcohol and ether than in water. It melts at about $125^{\circ}\text{C.} = 257^{\circ}\text{F.}$, and sublimes at about $200^{\circ}\text{C.} = 392^{\circ}\text{F.}$ † In common with other similar acids it forms salts with the principal bases, but these seem thus far to be difficult to make, and their effects have not been investigated.

It is used for medical and surgical purposes either dry or in solution. When used dry it is sprinkled on to wounds, ulcers, or dressings in the form of very fine powder, in very small quantities, either simply powdered, or mixed in various proportions with some diluent, such as starch. When used in simple solution either for spraying surfaces, or for washes or gargles, it is used in tepid solution of about 1 part to 300 parts of water. Where stronger solutions are required for washes, gargles, or to moisten dressings, 1 part of the acid and 3 parts of phosphate of sodium to 50 parts of water have been used. When applied to wounds it appears immediately in the urine.‡

Its alleged advantages over all other antiseptics are: First, that it is far more powerful and effective in smaller quantities; and secondly, that it is, in all quantities necessary for complete effectiveness, entirely devoid of irritant action upon the living tissues. It is not caustic nor corrosive in any quantity, and never produces inflammation. In large quantities it may be irritant and painful, but yet rarely surpasses a stimulant effect, while it appears to be quite neutral in the very small quantities which are yet thoroughly effective; thirdly, it is said to reach and prevent processes of decomposition which are beyond the reach of all other antiseptics or antiferments. These processes are of two kinds, namely—vital, or those in which living organisms have an important part, such as that produced by yeast and many of those which occur in putrefaction; and chemical, or those which occur independent of vitality, as the production of the volatile oils in mustard and bitter almonds, the effect of diastase, &c. Now, while carbolic acid and other anti-ferments are azymotic, or completely arrest or prevent fermentations of the first kind, they are powerless with the chemical processes. Salicylic acid is said to be more effective with the vital ferments, and equally effective with the chemical.

Fourthly, in quantities said to be thoroughly effective, it is entirely odourless and tasteless, and harmless, whilst it has no poisonous effect in any reasonable quantity.

It prevents or arrests the souring of worts, washes, and beers of the brewers, and prevents or arrests the putrefactive agencies which are so troublesome and destructive to the glue manufacturers; and these and similar trades have thus far seemed to be its principal consumers. Separate portions of fresh milk set aside to become sour, one to which 0.04 per cent of salicylic acid was added, soured thirty-six hours later than the other. Urine thus protected was on the third day still clear, and free from ammoniacal odour.

Varying proportions of the acid added to accurately measured separate portions of sweet milk, and these care-

fully observed afterward until they sour—or, by the use of meat juice instead of milk, observed closely for signs of putrefaction—would offer good indications of the quantities required to arrest these varieties of fermentation.

Professor Thiersch, of Leipsic,* used it upon contused and incised wounds, and in operations, with excellent general results, destroying the fetid odour of cancerous surfaces and pyæmic ulcerations. To such uses this writer would add the suggestion that for washing out the cavities of the abdomen and chest after those operations which tend so strongly to septicæmia, solutions of salicylic acid would seem to offer very great advantages should it prove to be as bland and unirritating as it is stated to be, and yet so effective.

Most of these statements are summed up from the periodical literature of continental Europe during the past six months, little having appeared upon the subject in Great Britain, or in this country, and nothing having been done with it so far as known in either country.

In occasional paragraphs and allusions benzoic acid has been coupled with salicylic acid as being only second to it in effectiveness as an anti-ferment, and with similar advantages.

These statements are collated and condensed here as being well worth attention in themselves, and in their relations to the phenomena of septic poisoning as already known. But they have a new significance, or at least suggest to this writer a new train of thought when viewed in connection with some researches now in progress and but just appearing in the periodical literature.

Experiments† were made upon animals by the injection of measured quantities of septic blood. The blood of a healthy animal was allowed to become putrid. Increasing doses of this were injected into healthy animals until the amount necessary to cause death was ascertained. This quantity proved to be large, the animals recovering from all the small doses. Blood from the animal whose death was caused by injections of putrid blood was injected in increasing doses into healthy animals until the fatal dose was reached, and this dose was found to be smaller than that which killed the first animal. The blood of the second dead animal was used on healthy subjects in the same way as that of the first, and proved fatal in still smaller quantity. The experiments were continued upon the same plan until finally a point was reached when a very minute portion—the fraction of a drop perhaps—from the last animal proved fatal to the next, with more violent toxic symptoms and a shorter course. The important indications of this series of experiments is of course the rapid accumulation of potency in septic poisoning. And the question put by this indication is not only as to how this potency accumulates, but also how to prevent and arrest it. Metro-peritonitis and common pyæmia would, doubtless, unobstructed, accumulate potency in the same way without visible inoculation, and often do continue and accumulate even against the vigorous application of the best means of prevention yet known. No hypothesis can be constructed that will embrace the phenomena of septic poisoning, as they are now rapidly being investigated without including zymotic diseases and the cachexiæ, and none will account for the phenomena already observed without bringing it within the sphere of what is called, in some of its degrees or phases, fermentation. Hence, if the medical art is to keep pace with the progress of the physical sciences, physicians cannot afford to pass by such articles as salicylic and benzoic acids when offered by chemistry, without investigating their effects upon disease, even though not one out of ten should repay the labour of investigation, for it is certainly in this

* *Pharm. Centralhalle*, Nos. 44 and 45, 1874.

† Bergman, Panum, Davaine, Vulpian, and Bouley—the latter researches in *Bulletins de l'Acad. de Med.*, 1872, 1873, and Davaine, translated by Mary C. Putnam, M.D., in *Archives of Scientific and Practical Medicine*, by C. E. Brown-Sequard and E. C. Seguin, No. 5, p. 469.

* Thiersch, *Pharm. Centralhalle*, Oct. 22, Nov. 5.

† Watts's "Chem. Dictionary," Art. "Salicylic Acid."

‡ Thiersch, as above cited.

direction of research that medicine must look with greatest hope of success to control those abnormal vital processes which so far may be modified, but not stopped. For example: Suppose a primary syphilitic or cancerous sore, or a diphtheritic patch, or even a cachectic pulmonary infection, while these are merely the localised phenomena of an external inoculation, or of an internal taint,—they must all be considered to partake of the nature of a fermentation, and by some such process invade the whole organism. Then suppose an anti-ferment, which when applied to any surface not covered by an impervious cuticle very soon appears unchanged, first in the blood, and then in the secretions and excretions,—the manifest logical antagonism of such substance to the diseased conditions becomes too important to be neglected, and the counsels of wisdom demand that its claims to such antagonism be disproved before it be dismissed. The question as to what may become of the cancer-cell, or of the less tangible precedent cause of it, or of the bacteria, or the precedent conditions which increase their fertility, under the well-directed influence of this class of agents, is, perhaps, the most important one in all medical science. And just in proportion as accurate research develops agents of greater and greater power, will be the prospect of better success in treatment.

The phenols, especially the so-called carbolic and cresylic acids (phenol and cresol), were, and must always remain to be, most important additions to this class of agents, surpassing in power all that had been previously tried. And if now salicylic acid shall prove more potent than the phenols the further gain will be very great, and the researches upon it will again lead up toward future discoveries of still greater power.

SOCIETY OF PUBLIC ANALYSTS.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—Mr. Allen has done good service by calling attention to the method of milk analysis recommended by Dr. Voelcker. I may add that the work in which it appears bears the date February, 1875, and that there is ample internal evidence that it is the method adopted by Dr. Voelcker in making the analyses of milk which are tabulated in the CHEMICAL NEWS of the 16th inst.

Dr. Voelcker's scheme of analysis appears to contain the following sources of error, some of which have been pointed out by Mr. Allen, but which may be conveniently recapitulated:—(1). The accurate weighing of 500 grains of milk in a dish is a matter of considerable difficulty, owing to the rapid evaporation which takes place from so large a surface of liquid, except the dish be very closely covered. This error is, however, unimportant. (2). The coagulation with acetic acid is a fertile source of error when the milk solids of so large a quantity of milk as 32 c.c. are to be dried till the weight is constant. The obtaining of anything like a constant weight necessitates a very prolonged exposure on the water-bath, and milk-sugar undergoes an appreciable loss when heated for long periods in acid solution. (3). It is impossible to obtain a constant weight by evaporating 500 grains of milk and crying at 100°; for whatever length of time the residue be exposed in the water, it still continues to lose weight. (4). The scraping of the residue from the dish, its pulverisation, re-drying, and re-weighing, must of necessity entail a loss, which will vary according to the skill of the operator. (5). The estimation of the nitrogen in one-fifth of the residue by combustion with soda-lime, is vicious. It has been more than once pointed out that the full yield of nitrogen is not obtained by the combustion of albumenoids with soda-lime. Recently Seegen and Novalk have shown (Pflüger's *Archiv. f. Physiologie*, vol. vi., p. 284) that the amount of nitrogen obtained in the form of

ammonia by combustion of the albumenoids with soda-lime is always less than that obtained in the gaseous form by combustion with cupric oxide. This loss may be so much as 20 per cent of the total nitrogen. The "casein and albumen" of Dr. Voelcker is evidently calculated from the nitrogen by multiplying this by 6.25, and all errors in the estimation of nitrogen are multiplied by this factor. The method employed accounts for the very low percentage of casein and albumen met with in milk by Dr. Voelcker. (6). The extraction of fat from a fraction only of the dried residue is sure to introduce experimental errors; and this operation should be most carefully performed, since the difference between the fat and the total solids gives the "solids not fat," the most important element in a milk analysis. For my own part I invariably make a direct estimation of the solids not fat.

The column headed milk-sugar in Dr. Voelcker's table cannot possibly be reliable, since it gives the figures obtained by calculation, performed thus. The nitrogen obtained by a defective method—an amount which may be 20 per cent in deficit—is multiplied by 6.25. The number thus obtained is added to the fat also obtained by a defective method, and the product is deducted from the total solids, obtained by a method which never yields constant results. As a consequence we find the Cirencester herd yielding a milk more than half the solids (52 per cent) of which consisted of milk-sugar.

In this last very extraordinary milk the ratio of albumenoids to sugar was 1 to 2.3, and that of fat to sugar 1 to 2.9. I venture to doubt whether anyone else has ever analysed a similar milk.—I am, &c.,

THOMAS STEVENSON.

Guy's Hospital, July 24, 1875.

ON MILK ANALYSIS.

To the Editor of the Chemical News.

SIR,—In the second edition of Normandy's "Chemical Analysis" (date, 1865) the following grotesque statement concerning milk occurs, page 379:—"Pure milk always consists of from 90 to 93 per cent of water." And it is not a misprint, since it is backed up by such statements as that milk yields 7 per cent of solid residue, and that, "according to Pfaff and Swartz," the ash of milk is 0.3044 per cent, &c.

This extract illustrates the condition of official knowledge at the time of Dr. Voelcker's notorious investigation into the "Composition of Morning and Evening Milk produced on the Royal Agricultural College Farm, Cirencester," (date, 1863).

I saw in a recent blue book that some Government official had been quoting Dr. Voelcker's results of 1863 against the conclusions arrived at by me in my little book on "Milk Analysis."

To that official I commend the passage in Normandy's book of 1865, which is two years later than the notorious investigation, and is, if possible, still more in opposition to me. In a third edition of Dr. Normandy's "Chemical Analysis," edited by Dr. H. M. Noad, (date, 1875), I do not find the passage about 90 per cent, but I do find what purports to be Dr. Voelcker's method of milk analysis, page 270. According to this account (which purports to have been furnished by the Doctor himself) 500 grains of milk is dried down, and then there is a powdering and a second drying and a weighing out of portions of the dried and powdered residue. Caseine is determined by means of the Will and Varrentrapp process (the nitrogen being multiplied by 6.25), milk-sugar is determined by difference.—I am, &c.,

J. ALFRED WANKLYN.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—I am glad that Mr. A. H. Allen has pointed out in his recent letter that, from the analytical numbers quoted in your report of some recent cases of milk adulteration

recently dismissed at Greenwich, the percentage of added water might have been stated at 12 per cent, or at even 15 per cent had the results been calculated from a standard of 9.3 per cent of total solids not fat. It has been my custom to "pass" a milk having a solid residue not fat of 9 per cent; but, in cases where there is no doubt that an adulteration has been practised, to calculate the amount of added water from the standard of 9.3 per cent of solids not fat. I think it only right and just for an analyst to assume that any sample of milk which he finds to be adulterated was, before adulteration, at least of average quality, and not of the very poorest possible quality consistent with its being a genuine milk. Referring to the complaints against some statements of Dr. Voelcker's, I suggest that it might be advisable for the Society of Public Analysts to lay before the Local Government Board the erroneous statements with regard to the analysis of milk made by Dr. Voelcker, together with the facts which prove that they are erroneous. Possibly, if copies of this were sent to the magistracy before whom the adulteration cases are brought, it would tend to place Dr. Voelcker's views on their proper basis, as compared with the present state of the knowledge of this subject.

It seems to be desirable, in my opinion, to establish as far as possible, for all analyses of foods, &c., a certain system of "standards" representing the specific indications afforded by the genuine articles. Doubtless, an enormous amount of work would have to be done, which would possibly take years to accomplish before that could be effected, because, for every sort of article, three points at least would have to be discovered, viz.,—(1) a trustworthy index, (2) what was actually the "standard," and (3) a perfectly safe and practical process for the analytical determinations of the samples being examined.

This has already been accomplished for milk, tea, very recently for butter, and something has also been done for cocoa mixtures (*i.e.*, the determination of the cocoa-fat). I should like to see these "standards," when thoroughly known to be accurate, made into legal definitions.

Moreover, I think that the use of such "standards" would overcome many difficulties, because the question then at issue would be, not whether a certain article was adulterated to a certain extent, but whether or not it was up to the "standard" for that article. This would prohibit the sale, unless under some such condition as information to the purchaser at the time of purchase, of articles actually genuine, but of such an inferior quality as to be worse than if intentionally adulterated; and, in the case of milk, it would prevent any magistrate from dismissing, almost with a blessing, a vendor of milk brought before him who sold milk so bad that, when viewed in its best possible aspect, was only equal in quality to the very poorest milk, *known to be genuine, plus 10 per cent of added water.*—I am, &c.,

CHARLES H. PIESSE.

303, Strand, London,
July 26, 1875.

MILK SOLIDS.

To the Editor of the Chemical News.

SIR,—The subject of "Milk Solids" is remarkable for its vitality. I had hoped by this time a fair standard had been agreed upon free alike from special starvation and exaggerated richness. The limit of the Society is fair, however, by the law of averages and no other; even at this a marginal line exists, a thin one perhaps, but "A cow is not yet a mathematical figure."

My object is to refer to another limit, butter fat. This is also agreed upon; but even the moderate figure of 2.5 per cent will create a positive injustice unless some more careful and perfect mode of distribution by the vendor is adopted. The proportion of cream in the first and the last issue from the common can has engaged the attention of some few experimentalists.

I anticipate the chance of doing a possible injustice by certificate, a matter that should dwell thoroughly in the

mind of each Analyst, hence these few lines. The only suggestion I can make is, that as 99 per cent of samples are obtained by officers instructed to obtain—"the public not liking the office of prosecutor"—an instruction to fairly obtain milk samples be given, and to that issue the officer should advise the vendors themselves. Failing some such action, discrepancies will occur leading to much difference of opinion, already wide enough.—I am, &c.,

EDWARD MOORE.

Brighton, July 24, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxx., No. 25, June 28, 1875.

Distribution of Magnetism in a Thin Plate of Great Length.—M. J. Jamin.—The author has been engaged in studying the distribution of magnetism in a bundle of rods, commencing with the most simple case, that of a single broad plate, so long that it may be regarded as infinite, and of an equal thickness of 1 millimetre. He has experimented upon various pieces taken from a long and very homogeneous band of steel.

Distribution of an Acid among several Bases in Solution.—M. Berthelot.—Berthollet, who first took up the question of the distribution of acids and bases in solutions, admits that each acid and each base plays a part determined by its capacity of saturation and its quantity, that is to say, by its chemical mass. If the weights are equal, we should say, at present, that each body acts in the inverse ratio of its equivalent; whilst, if the two bases are employed in equivalent weights, they will each take the half of the acid. Such is the exact rendering of the language of Berthollet, which formally excludes every idea of an elective affinity or of a specific coefficient. But such distribution can only subsist if both the bases and the salts which they form remain in solution. If one of these bodies is withdrawn, whether by volatility or insolubility, a new distribution takes place in the liquid, and, in consequence, a new elimination; and so on until the totality of the eliminable compound is removed from the field of chemical action. Such are the principles of Berthollet's "Chemical Statics." Gay-Lussac invoked the same mechanism, but placing himself at a different point of view. He admits in solutions a sort of pell-mell, of equipollence of bases and acids shared out uniformly, the compounds which appear only originating in the moment when they are separated by insolubility, crystallisation, or volatility. These opinions the author has undertaken to examine by thermic methods, as far as the bases are concerned. He finds that the double salts, and the changes of the solvent, are not the cause of the phenomena observed; whilst, in the case of lime and ammonia, everything is explained by the chemical and total substitution of lime—an insoluble base for ammonia, a soluble base in the hydrochlorate of ammonia. We see thus that, contrary to the laws of Berthollet, a soluble base may be displaced in soluble salts by an insoluble base, which thus enters into solution.

Hydrocarbons Formed on the Distillation of Crude Fatty Acids in Presence of Superheated Steam.—MM. A. Cahours and E. Demarcay.—The hydrocarbons in question proved to be hydride of heptyl; hydride of octyl boiling between 118° and 120°; its specific gravity in the liquid state being 0.723, and its vapour-density 3.994, which agrees with the formula $C_{16}H_{18}$. Hydride of nonyl boiling between 138° and 140°, its specific gravity when liquid being 0.744, and its vapour-density 4.475. Hydride

of decyl, boiling between 158° and 160° ; specific gravity 0.758, vapour-density 4.978. Hydride of undecyl, boiling between 176° and 178° ; specific gravity 0.770, vapour-density 5.488. Finally, a small quantity of a limpid liquid boiling towards 200° , with a specific gravity of 0.784. It is probably the hydride of duodecyl.

Note on Tubular Electro-Magnets with Multiple Nuclei.—M. Th. du Moncel.—A detailed examination of the action of Camacho's electro-magnets.

Note Accompanying the Presentation of Vol. I. of "Analytical and Experimental Exposition of the Mechanical Theory of Heat."*—M. Hirn.—The author seeks in this work to disentangle the science of thermodynamics from the metaphysical hypotheses by which it has been hitherto accompanied.

Influence of Compressed Air upon Fermentations.—M. P. Bert.—Oxygen at high pressures arrests fermentations, properly so called, which do not then reappear until the normal pressure is re-established. It kills the ferment germs. It is without appreciable action upon ferments of the diastase group, which it permits to remain active for an indefinite time. We comprehend that this new method of analysis may be usefully applied to the study of phenomena on which physiologists are still divided. Do the blood of carbuncle, the blood of infectious diseases, pathological liquids, animal poisons, &c., owe their action to corpuscles analogous to true ferments, or to an alteration of the fluids acting in the manner of a diastatic ferment?

Study of Electric Discharges in Fine Metallic Wires.—M. Melsens.—Not adapted for abstraction.

Influence of Magnetism upon the Extra Current.—M. Trève.—The author had formerly announced to the Academy that the intervention of magnetism had the effect of modifying the colouration of rarefied gases traversed by an induction current, and of transforming their spectra. It results from his present experiments that these effects are due as much to a change in the temperature of the gases as to a change in their pressure.

Chemical Equivalence of the Alkalies in the Ashes of Plants.—MM. P. Champion and H. Pellet.—In an earlier paper the authors have shown that the amounts of sulphuric acid necessary to saturate separately all the alkalies contained in the ash of beets (roots and leaves) may vary within remote limits, but that their sum is sensibly constant; or, in other words, that the partial substitution of alkalies takes place according to chemical equivalents. Further researches have led them to conclude that this law applies not merely to the beet, but to a great part of the vegetable kingdom, if not to the whole. They find in particular that, in the ash of tobacco, lime and potash replace each other according to their chemical equivalents.

Presence of the Peroxide of Hydrogen in the Sap of Plants.—M. J. Clermont.—It results from the researches of Schönbein and Meissner that the molecule of oxygen, which they regard as diatomic, is transformed under the influence of electricity into ozone (–) and antozone (+), one of the two atoms composing the molecule being charged with negative, and the other with positive electricity. Antozone, or electro-positive oxygen, cannot be produced without a parallel development of electro-negative ozone, and *vice versa*. M. Meissner has further shown that antozone has the power of causing water to pass to a higher state of oxidation, HO_2 . On the other hand, it appears that a great part of the oxygen liberated by plants is found in the state of ozone. The author has, from these considerations, been led to seek for peroxide of hydrogen in the juice of a great variety of plants, such as tobacco, the vine, lettuce, &c. The plants were quickly bruised in a vessel containing distilled water, which being then examined with Schönbein's test—a mixture of iodide of potassium, starch, and a proto-salt of

iron—gave distinct indications of the presence of peroxide of hydrogen.

Action of Chlorine upon Isobutyl-Hydriodic Ether.—M. Prunier.—If dry chlorine is passed into this ether, kept at a low temperature, at first $\text{C}_8\text{H}_9\text{Cl}$ is formed, and iodine is thrown down. If the entrance of the gas is regulated so as to avoid heating, and the distillation of hydrochloric ether, chloride of iodine is formed, and substitution begins.

Supporting Power of M. Jamin's Magnets.—M. A. Sandoz.—The author finds that the magnets in question do not lose strength in time, but rather increase. That there is no sensible gain from leaving them with an armature, and that they preserve their power equally with or without. That the supporting power of a magnet whose load has been successively torn away varies somewhat, but, upon the whole, gains rather than loses.

Justus Liebig's Annalen der Chemie,
June 25, 1875.

New Apparatus for the Determination of Gases by Absorption.—Dr. G. von Liebig.—A long and important paper, which would not be intelligible without engravings.

Penta-Methyl-Athol and its Derivatives.—H. A. Butlerow.—The author has obtained a tertiary alcohol, which may be regarded as ethyl-alcohol in which the five hydrogen atoms of the radical are replaced by methyl groups. This compound he names penta-methyl-äthol. He has also examined the chloride of penta-methyl-ethyl, $\text{C}_7\text{H}_{16}\text{Cl}$, and the corresponding iodide.

Action of Bromine upon Protocatechuic Acid, Gallic Acid, and Tannin.—J. Stenhouse.—A detailed account of researches first published in the *CHEMICAL NEWS*, vol. xxix., p. 95.

Action of Bromine upon Brom-Pyro-Gallol, and Brom-Pyro-Catechin.—J. Stenhouse.—An abstract of this paper also appeared in the *CHEMICAL NEWS*, vol. xxix., p. 96.

Constitution of Completely Substituted Amidic and Phosphidic Acid: Compounds of Pentavalent Nitrogen and Phosphorus.—J. W. Brühl.—In this treatise the author describes the preparation of triethylated amido-acetic acid; the action of powerful bases upon the chloride of this compound; the elementary analysis of triethyl-glycocol, $\text{C}_{18}\text{H}_{17}\text{NO}_2$; the action of hydrate of baryta upon triethyl-amido-acetic acid at high temperatures; and the results of the dry distillation of triethyl-amido-acetic acid.

Action of Aniline upon Dichlorhydrin.—Hugo Schiff.—On heating to 200° 1 molecule dichlorhydrin with 5 of aniline a crude mass was obtained, from which excess of aniline and hydrochlorate of aniline were removed by treatment with warm dilute acetic acid. The red vitreous residue was dissolved in absolute alcohol slightly acidulated with hydrochloric acid, and the solution mixed with ether. A slight red precipitate (A) was obtained. The filtrate, on evaporation, yielded the same vitreous mass, which was only partially dissolved on repeated digestion in dilute hydrochloric acid. A deep red granular mass (B) remained undissolved, whilst a yellow powder (C) was thrown down by ammonia from the hydrochloric solution. A is formed only in small amount. It is soluble in alcohol, insoluble in ether, water, and dilute hydrochloric acid. From its alcoholic solution it is precipitated by acidulated water as a brick-red powder, containing—

| | |
|----------------|------|
| Carbon | 73.2 |
| Hydrogen | 7.2 |

B, the main product of the reaction, forms, when purified like A, a deep red granular mass. The hydrochloric alcoholic solution yields, on gradual evaporation, a dichroic, red-green, unstable hydrochlorate, which yields hydrochloric acid if treated with water, but without dissolving. C in the moist state is chiefly re-soluble in dilute hydro-

* "L'Exposition Analytique et Expérimentale de la Théorie Mécanique de la Chaleur."

chloric acid, but if dried over sulphuric acid it becomes very sparingly soluble. It contains—

| | |
|------------------|------|
| Carbon | 77.4 |
| Hydrogen | 7.7 |

On Meta-Brom-Toluol.—Dr. E. A. Grete.—This paper treats of the preparation of meta-brom-toluol; of meta-brom-sulphitoluol and its calcium, strontium, magnesium, copper, lead, and potassium compounds; and concludes that the sulphi-acid produced by the reaction of meta-brom-toluol with fuming sulphuric acid, and corresponding to salicylic acid, belongs to the ortho series, and is consequently meta-brom-ortho-sulphi-toluol. The author further examines mono-nitro-meta-brom-toluol, mono-amido-meta-brom-toluol, meta-brom-amido-toluol sulphate, nitrate, hydrochlorate, and oxalate of meta-brom-toluydin; meta-brom-acettoluydin; dinitro-meta-brom-toluol; diamido-meta-brom-toluol, with its sulphate, hydrochlorate, nitrate, and oxalate.

Derivatives of Glycerin.—K. Kraut.—An examination of compounds formed by the action of iodides of ethyl and of methyl upon glycin in alcohol.

Action of Iodide of Methyl upon Alcohol.—E. Busse and K. Kraut.—10 c.c. iodide of methyl were heated for twelve hours to 120° to 125° along with 30 c.c. of commercial absolute alcohol. In the cooled liquid the iodine compounds were precipitated with water, washed, dried with chloride of calcium, and distilled. The greater portion of the liquid passed over above 65°. The part passing over at lower temperatures was again heated with the triple volume of alcohol, separated, washed, dried, and added to the portion first obtained. In this manner were obtained 10 grms. of a product boiling between 65° and 71°, from which mellitic-acid-ester was obtained by contact with mellitate of silver.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus for purifying sewage waters. James McIntyre, Port Glasgow, Renfrew, N.B. September 21, 1874.—No. 3225. In carrying out the invention, according to one modification, two depositing tanks are constructed side by side in the line of a sewer, and the sewer is connected to each by separate inlet and outlet branch passages fitted with sluices. Each tank is made to extend down a considerable depth below the sewer level, but the outlet from it is made higher than the inlet, and the sewage waters flow in and fill up the tank until they reach this higher discharge level, the water flowing off as it rises above that level. When a sufficient deposit has lodged in one tank, the sluices are changed so as to direct the sewage waters through the other tank, and the deposit in the first tanks is removed. The essential features are the arrangements for obtaining the deposition of suspended matters whilst the sewage waters flow continuously through the apparatus.

Improvements in the manufacture of soda and potash. James Mactear, chemist, of Glasgow, Lanark, North Britain. September 22, 1874.—No. 3242. By the present invention, a mixture of sulphate of soda or potash with coal and with a quantity of carbonate of lime barely in excess of the chemical equivalent is charged at one time into the furnace, and the heating operation is allowed to proceed until the reaction is nearly complete. At this point a small quantity, say 10 per cent, of crushed caustic lime is added; and then, as soon as this added caustic lime is thoroughly mixed with the other materials, the entire charge is withdrawn.

A new method of treatment of slops, bloody waters, and other forms of liquid refuse, and for apparatus to be used therein. Francis Thos. Bond, Gloucester. September 29, 1874.—No. 3326. The mode described consists of a combination of precipitation by certain chemical agents, —such as sulphuric acid, sulphate of alumina, &c., in the case of soapy waters, and sulphate of copper and bichromate of potash in the case of bloody waters,—with subsequent filtration, either by means of a floating strainer or a submerged filter specially constructed for the purpose. The process is carried on in a barrel, tub, or other appropriate vessel, open at the top and provided with a tap connected by india-rubber tubing with the strainer or filter aforesaid.

Improvements in the purification of sugar solutions. Charles Haughton Gill and George Martineau, both of Christian Street, Middlesex. September 29, 1874.—No. 3332. This Specification describes adding an excess of tannin to sugar solutions, and subsequently removing this excess by the addition of alumina.

Improvements in treating saccharine solutions to separate potash therefrom. Charles Haughton Gill and Francis Neison Girdlestone Gill, both of Christian Street, Middlesex. September 29, 1874.—No. 3333. Oxalic acid is the agent employed.

Improvements in the process and apparatus employed in the making and condensing of oxygen and hydrogen gases. Joseph Beck, optician, Cornhill, London. (A communication from N. H. Edgerton, Philadelphia, Pennsylvania, U.S.A.) October 2, 1874.—No. 3366. The process consists in the making and condensing, by molecular action, oxygen and hydrogen gases in a solid wrought-iron cylinder of peculiar construction.

Improvements in the treatment of human excreta, and in the manufacture of manure therefrom, and in the apparatus employed therein. Francois Alcidi Bonnefin, Island of Mauritius, at present residing at Queen Street, Cheapside, London. October 3, 1874.—No. 3384. My invention relates to the treatment of human excreta and to the production of manure therefrom, and consists of a peculiar process of and apparatus for effecting the deodorisation or disinfection of the solid and liquid portions together, and of the liquid portions separately, in order to fix the salts and gases, and render the excreta capable of being employed as a manure for agricultural purposes.

Improvements in preserving wood. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Henri Nicolas Rogé, Edouard Poret, Pierre Hypolite Baffoy, and Pierre Stanislas Eléonore Dupré, all of Paris, France). October 3, 1874.—No. 3392. The invention consists in the use in combination of a salt of lead and a reagent capable of producing an insoluble compound of lead by precipitation, after impregnating the pores of the wood for the purpose of preserving the same.

A new method for the saving of nitre in the manufacture of sulphuric acid, and apparatus therefor. Thomas Scott, The Glen, Cork, Ireland. October 6, 1874.—No. 3417. A series of tanks are arranged to receive the gases, sulphurous and nitrous, from furnaces, the gases passing through tubes, some containing flints and others coke, to separate one gas from the other after the acid has been condensed in the tanks.

Improvements in the mode of treating and clarifying sewage or other impure waters. Samuel Hallsworth, Armley, near Leeds, and Richard Bailes, Woodhouse Carr, Leeds, both of York. October 9, 1874.—No. 3459. This consists in the employment of liquid obtained from beds of iron pyrites. Means are described for treating the impure waters.

Improvements in the manufacture of ammoniacal salts. Henry Young Daracott Scott, Major-General, C.B., Ealing, Middlesex. October 9, 1874.—No. 3472. The object of this invention is to obtain salts of ammonia from ammoniacal phosphate of magnesia in an economical manner, so that after the extraction of the ammonia from that substance the phosphate of magnesia may be again used for the extraction of fresh portions of ammonia from gas liquor, decomposed urine, and other ammoniacal liquids.

Improvements in obtaining chlorine. Joseph Townsend, manufacturing chemist, Glasgow, Lanark, North Britain. October 10, 1874.—No. 3483. This invention has for its object the obtaining of chlorine in a better and more economical manner than heretofore, and consists in passing gaseous hydrochloric acid and atmospheric air in contact with heated mixtures or compounds of manganese and magnesium or their oxides, a result of the reaction taking place being the evolution of chlorine, which may be utilised or applied in any suitable known way.

Improvements in the preparation of anodes of nickel for the purpose of nickel plating. John Wm. Perkins, Arlington Lodge, Herne Hill Road, Brixton, Surrey. October 19, 1874.—No. 3587. The novelty of this invention consists in alloying tin with nickel.

Improvements in the extraction of metals from their ores. Stephen Henry Emmens, scientific referee, Old Jewry, London. October 20, 1874.—No. 3609. This relates to the use of fluor spar in the roasting process, a solution of salt or saltpetre in the lixiviating process, and iron pyrites in the precipitating process.

Improvements in the means of purifying and clarifying the refuse water of breweries, distilleries, sugar refineries, starch works, tanneries, and similar establishments wherein water is contaminated. Frederick Arthur Paget, engineer, Seymour Chambers, Adelphi, London, and Riemer Gasse Stadt, Vienna, Austria. (A communication from Jean Alexandre Bérenger, engineering inspector of the Austrian Southern Railway, and Johann Stingl, private tutor in the Chemical Laboratory of the Imperial and Royal Polytechnic Institution, both persons resident at Vienna, Austria). October 20, 1874.—No. 3613. The preliminary treatment of such water. First, with a mixture of sesquichloride of iron and of chloride of aluminium. Treating water already so prepared with milk of lime or with lime-water. The employment for these purposes of a self-acting apparatus continuous in its action, substantially as described in Specification No. 3953, A.D. 1873. The use of the mixture as described prepared by the reaction of hydrochloric acid on argillaceous iron ore containing phosphorus. Employing any known disinfecting substance for treating water previously prepared by the method substantially as described.

Improvements in dyeing threads, yarns, and fabrics aniline-black. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from William Jules Samuel Grawitz, Paris, France). October 21, 1874.—No. 3632. This invention relates to dyeing all kinds of fibres, yarns, threads, or fabrics black, or shades approaching thereto, by means of oil of aniline or its salts, and the following reagents, viz.:—1st, soluble chromate or bichromate, or soluble chlorate; and 2ndly, salt of iron or copper at a maximum degree of basic oxidation.

TO CORRESPONDENTS.

ERRATA.—Page 28, line 32 from top, for "powerful" read "prompt;" line 37, for "20" read "29;" line 11 from bottom, for "thus" read "then."

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PRELIMINARY NOTICE OF FURTHER RESEARCHES ON THE PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES UNDER VARIED CONDITIONS OF PRESSURE AND TEMPERATURE.*

By Dr. ANDREWS, F.R.S.,
Vice-President of Queen's College, Belfast.
(Concluded from page 44).

Law of Gay-Lussac.—That the law of Gay-Lussac in the case of the so-called permanent gases, or in general terms of cases greatly above their critical points, holds good at least at ordinary pressures, within the limits of experimental error, is highly probable from the experiments of Regnault; but the results I have obtained with carbonic acid will show that this law, like that of Boyle, is true only in certain limiting conditions of gaseous matter, and that it wholly fails in others. It will be shown that not only does the coefficient of expansion change rapidly with the pressure, but that, *the pressure or volume remaining constant, the coefficient changes with the temperature.* The latter result was first obtained from a set of preliminary experiments, in which the expansion of carbonic acid under a pressure of 17 atmospheres was observed at 4°, 20°, and 54°; and it has since been fully confirmed by a large number of experiments made at different pressures and well-defined temperatures. These experiments were conducted by the two methods commonly known as the method of constant pressure and the method of constant volume. The two methods, except in the limiting conditions, do not give the same values for the coefficient of expansion; but they agree in this respect, that at high pressures the value of that coefficient changes with the temperature. While I have confined this statement to the actual results of experiment, I have no doubt that future observations will discover, in the case, at least, of such gases as carbonic acid, a similar, but smaller, change in the value of the coefficient for heat at low pressures. The numerous experiments I have made on this subject will shortly be communicated in detail to the Society; and for the present I will only give the following results:—

Expansion of Heat of Carbonic Acid Gas under High Pressures.

| Pressure. | Vol. CO ₂ at 0° and 760 m.m.=1. | Vol. CO ₂ at 6.05° and 22.26 At.=1. | Temperature. |
|--------------|--|--|--------------|
| Atmospheres. | | | Degrees. |
| 22.26 | 0.03934 | 1.0000 | 6.05 |
| 22.26 | 0.05183 | 1.3175 | 63.79 |
| 22.26 | 0.05909 | 1.5020 | 100.10 |
| | | | (A) |
| Pressure. | Vol. CO ₂ at 0° and 760 m.m.=1. | Vol. CO ₂ at 6.62° and 31.06 At.=1. | Temperature. |
| Atmospheres. | | | Degrees. |
| 31.06 | 0.02589 | 1.0000 | 6.62 |
| 31.06 | 0.03600 | 1.3905 | 63.83 |
| 31.06 | 0.04160 | 1.6068 | 100.64 |
| | | | (B) |
| Pressure. | Vol. CO ₂ at 0° and 760 m.m.=1. | Vol. CO ₂ at 6.01° and 40.06 At.=1. | Temperature. |
| Atmospheres. | | | Degrees. |
| 40.06 | 0.01744 | 1.0000 | 6.01 |
| 40.06 | 0.02697 | 1.5464 | 63.64 |
| 40.06 | 0.03161 | 1.8123 | 100.60 |
| | | | (C) |

* A Paper read before the Royal Society.

Taking as unit 1 vol. of carbonic acid at 6.05° and 22.26 atmospheres, we obtain, from series A, the following values for the coefficient of heat for different ranges of temperature:—

$$\alpha = 0.005499 \text{ from } 6.05^\circ \text{ to } 63.79^\circ.$$

$$\alpha = 0.005081 \text{ from } 63.79^\circ \text{ to } 100.10^\circ.$$

From series B, with the corresponding unit volume at 6.62° and 31.06 atmospheres, we find:—

$$\alpha = 0.006826 \text{ from } 6.62^\circ \text{ to } 63.83^\circ.$$

$$\alpha = 0.005876 \text{ from } 63.83^\circ \text{ to } 100.64^\circ.$$

And in like manner, from series C, with the unit volume at 6.01° and 40.06 atmospheres:—

$$\alpha = 0.009481 \text{ from } 6.01^\circ \text{ to } 63.64^\circ.$$

$$\alpha = 0.007194 \text{ from } 63.64^\circ \text{ to } 100.60^\circ.$$

The coefficient of carbonic acid under 1 atmosphere referred to a unit volume at 6° is—

$$\alpha = 0.003629.$$

From these experiments, it appears that the coefficient of expansion increases rapidly with the pressure. Between the temperatures of 6° and 64° it is once and a half as great under 22 atmospheres, and more than two and a half times as great under 40 atmospheres, as at the pressure of 1 atmosphere. Still more important is the change in the value of the coefficient at different parts of the thermometric scale, the pressure remaining the same. An inspection of the figures will also show that this change of value at different temperatures increases with the pressure.

Another interesting question, and one of great importance in reference to the laws of molecular action, is the relation between the elastic forces of a gas at different temperatures while the volume remains constant. The experiments which I have made in this part of the inquiry are only preliminary, and were performed, not with pure carbonic acid, but with a mixture of about 11 volumes of carbonic acid and 1 volume of air. It will be convenient, for the sake of comparison, to calculate, as is usually done, the values of α from these experiments; but it must be remembered that α here represents no longer a coefficient of volume, but a coefficient of elastic force.

Elastic Force of a Mixture of 11 vols. CO₂ and 1 vol. Air Heated under a Constant Volume to Different Temperatures.

| Vol. CO ₂ . | Temperature, Degrees. | Elastic Force, Atmospheres. |
|------------------------|--------------------------|--------------------------------|
| 366.1 | 13.70 | 22.90 |
| 366.2 | 40.63 | 25.74 |
| 366.2 | 99.73 | 31.65 |
| 256.8 | 13.70 | 31.18 |
| 256.8 | 40.66 | 35.44 |
| 256.8 | 99.75 | 44.29 |
| | | (A) |
| | | (B) |

From series A we deduce, for a unit at 13.70° and 22.90 atmospheres:—

$$\alpha = 0.004604 \text{ from } 13.70^\circ \text{ to } 40.63^\circ.$$

$$\alpha = 0.004367 \text{ from } 40.63^\circ \text{ to } 99.73^\circ.$$

And from series B:—

$$\alpha = 0.005067 \text{ from } 13.70^\circ \text{ to } 40.66^\circ.$$

$$\alpha = 0.004804 \text{ from } 40.66^\circ \text{ to } 99.75^\circ.$$

The coefficient at 13.70° and 1 atmosphere is—

$$\alpha = 0.003513.$$

It is clear that the changes in the value of α , calculated from the elastic forces under a constant volume, are in the same direction as those already deduced from the expansion of the gas under a constant pressure. The value of α increases with the pressure, and it is greater at lower than at higher temperatures. But a remarkable relation exists between the coefficients in the present case which does not exist between the coefficients obtained from the expansion of the gas. The values of α , deduced for the same range of temperature from the elastic forces at different

pressures, are directly proportional to one another. We have, in short—

$$\frac{0.004367}{0.004604} = 0.9485, \quad \frac{0.04804}{0.05067} = 0.9481.$$

How far this relation will be found to exist under other conditions of temperature and pressure will appear when experiments now in progress are brought to a conclusion.

Law of Dalton.—This law, as originally enunciated by its author, is, that the particles of one gas possess no repulsive or attractive power with regard to the particles of another. "Oxygen gas," he states, "azotic gas, hydrogenous gas, carbonic acid gas, aqueous vapour, and probably several other elastic fluids, may exist in company under any pressure and at any temperature without any regard to their specific gravities, and without any pressure upon one another." The experiments which I have made on mixtures of carbonic acid and nitrogen have occupied a larger portion of time than all I have yet referred to. They have been carried to the great pressure of 283.9 atmospheres, as measured in glass tubes by a hydrogen manometer, at which pressure a mixture of 3 volumes of carbonic acid and 4 volumes of nitrogen was reduced, at 7.6°, to $\frac{1}{378}$ th of its volume without liquefaction of the carbonic acid. As this note has already extended to an unusual length, I will not now attempt to give an analysis of these experiments, but shall briefly state their general results. The most important of these results is *the lowering of the critical point by admixture with a non-condensable gas*. Thus, in the mixture mentioned above of carbonic acid and nitrogen, no liquid was formed at any pressure till the temperature was reduced below -20°C . Even the addition of only $\frac{1}{10}$ th of its volume of air or nitrogen to carbonic acid gas will lower the critical point several degrees. Finally, these experiments leave no doubt that the law of Dalton entirely fails under high pressures, where one of the gases is at a temperature not greatly above its critical point. The anomalies observed in the tension of the vapour of water when alone and when mixed with air find their real explanation in the fact that the law of Dalton is only approximately true in the case of mixtures of air and aqueous vapour at the ordinary pressure and temperature of the atmosphere, and do not depend, as has been alleged, on any disturbing influence produced by a hygroscopic action of the sides of the containing vessel. The law of Dalton, in short, like the laws of Boyle and Gay-Lussac, only holds good in the case of gaseous bodies which are at feeble pressures and at temperatures greatly above their critical points. Under other conditions these laws are interfered with; and in certain conditions (such as some of those described in this note) the interfering causes become so powerful as practically to efface them.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.
(Continued from p. 26.)

THIS report resulted from the minute investigations of MM. Péligot, Lamy, Troost, De Mondésir, and Le Blanc, who had been appointed as commissioners by the Prefect of the Seine in 1869. They undertook an examination of the process in the Place de l'Opera as well as in the laboratory. They burnt ordinary gas, bog-head gas, and gas saturated according to different systems with liquid hydrocarbons, along with about half its volume of oxygen, and making use of various burners. They came to the conclusion that, for an equal intensity of light, the process of

Tessié du Motay is almost always dearer—generally twice as dear—as the ordinary mode of lighting. In one case only, where the liquid hydrocarbons of the Boghead coal were used for carburetting by absorption in wicks, according to the plan of Levêque, over which the gas passed, it was found that the new process was twice as cheap as the ordinary method. This, moreover, applied only to the use of large burners, and the consequent production of great quantities of light. All the figures given by Tessié du Motay's Company, as to the cost of oxygen and the expense of carburetting, were taken for granted. In fact, however, it appeared that, in this experiment, 1 cubic metre of gas took up, not 50 grms. of liquid hydrocarbons, as the Company stated, but 266 grms., which rendered the economy of the process at any rate doubtful. As regards the strength of the light, the commissioners found it from three to seven times greater than that of common coal-gas. But Boghead gas in suitable burners can be made to yield a light three times stronger than that of coal-gas without the aid of pure oxygen. For most purposes, moreover, a very great intensity of light is not desired, as we see it reduced to 30 per cent by means of glass shades and screens.

The conclusion of the commission, therefore, was to advise the municipality of Paris not to permit the laying down of mains for oxygen gas, but to leave it to the Company to furnish oxygen and carburetted gas in portable gasometers to such persons as required an intense light.

The results obtained in Brussels were not more favourable. Lighting with oxygen was tried there last year for a short time in some coffee-houses and in the Passage St. Hubert, and given up on account of the above-mentioned disadvantages.* In Vienna, in April, 1874, the Westbahnhof was still lighted up with oxygen; but the system had made no further progress in that city, and the bluish moon-like light, in spite of its intensity and beauty, as represented above, was regarded as unsatisfactory.† The jury of the Vienna Exhibition examined the oxygen illumination at the Westbahnhof (Western Railway Terminus). In the Exhibition itself the manufacture of oxygen was not represented.

Should further experience confirm these decisions, the manufacture of oxygen would be deprived of its present foundations. For it has been undertaken solely in the hope of the application of the oxygen to lighting purposes.

Many of the above-mentioned disadvantages, and especially the cost of the mains, are evaded in the arrangement which Phillips‡ proposes for oxygen illumination. This depends on lamps (manufactured by Berghausen, of Cologne), fed from an oil-cistern with very heavy tar-oil, rich in naphthalin, whilst oxygen is introduced into the centre of the wick. Whether great cities will be induced to give up the advantages of gas-lighting in favour of this arrangement, and whether it is practicable on the large scale, must be considered very doubtful.

(To be continued.)

ON A METHOD OF MEASURING REFRACTIVE INDICES WITHOUT THE USE OF DIVIDED INSTRUMENTS.

THE importance of an accurate determination of all the physical constants which characterise any substance having a definite chemical constitution becomes daily more and more evident. The researches of Gladstone, Landolt, and others have shown that indices of refraction possess a peculiar value and interest. As the instruments necessary for their determination are expensive, and often

* Letters from M. Melsens, Professor of Chemistry in Brussels, to Professor A. W. Hofmann, April 14th, 1874.

† Verbal communications from H. Hlasiwetz, Professor of Chemistry at the Polytechnicum in Vienna.

‡ Phillips, "Der Sauerstoff," Berlin, 1871, p. 46.

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

beyond the reach of working chemists, a simple and sufficiently accurate method of measuring them by means of the spectroscope alone will doubtless be welcomed.

The method which I propose is one of comparison, and applies with convenience only to the case of liquids. A hollow prism is to be filled with the liquid to be examined, placed upon the stage of the spectroscope, and turned until a given ray—the line *D*, for instance—is seen by the observing telescope to be in the position of minimum deviation. The eye-piece of the telescope should have two parallel spider-lines placed very near each other in the plane of the diaphragm. When the dispersion is sufficiently great to separate the line *D* into its two components, either component may be made to bisect the interval between the two spider-lines, or the two components may be made to occupy such positions that their middle line shall bisect the interval. The observing telescope is then to be firmly clamped. The prism is now to be removed, the liquid poured out, and the prism cleaned and dried carefully. It is then to be filled with any liquid the indices of refraction of which are known, and which the observer judges to have a mean index not greatly differing from that of the liquid to be measured. The prism is to be placed upon the stage of the spectroscope, and turned until the observer ascertains that the two spectra would be in the field of view if both could be seen at the same time; or, what is the same thing, that they would be more or less completely superposed. Should this not be the case, another comparison-liquid must be chosen, and so on until one is found which fulfils the requisite conditions. Supposing that this is successfully accomplished, the prism is to be turned until, for the position of minimum deviation, a known line in the spectrum exactly bisects the interval between the two spider-lines. The index of refraction of the given liquid for the line *D* is then the same as that of the known line in the spectrum of the liquid used for comparison; for we have for each case—

$$n = \frac{\sin. \frac{1}{2}(P+D)}{\sin. \frac{P}{2}} \quad n' = \frac{\sin. \frac{1}{2}(P+D')}{\sin. \frac{P}{2}},$$

and, since *P* is constant, and *D'*=*D*, it follows that *n'*=*n*.

By this method, the index of refraction of a given liquid may be determined for a single line; as, for instance, for *D*. This is sufficient for the optical analysis in the form in which it has been developed by Landolt. Two objections to this method present themselves at once. The first is the necessity of finding, by tentative processes, a comparison-liquid which shall have about the same mean index of refraction as the liquid an index of which is to be determined. I admit the force of the objection, but it must not be estimated too highly. Whole classes of liquids agree pretty nearly in their optical characters; as, for instance, the oils of the $C_{10}H_{16}$ series, the ethers of the fatty acids, hydrocarbons, and saline solutions. The second objection is, that, with liquids of low dispersive powers, it is not easy to distinguish the spectral lines with absolute certainty. This difficulty is easily avoided by using a second prism, with a high dispersive power, placed next to the collimator, so as to form a long spectrum, which shall fall upon the trial-prism. The final dispersion is then the sum of the dispersions of the two prisms, and no difficulty will be found in distinguishing the spectral lines. It is, of course, necessary that the subsidiary prism shall have the same position in both cases. Two or more subsidiary prisms, either of flint-glass or of carbonic disulphide, may be used with great advantage, but one will usually be found sufficient. The indices of refraction of the comparison-liquids being known for at least three lines, the values of the constants, *a*, *b*, and *c*, in Cauchy's formula—

$$n = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4},$$

may be determined. It then only remains to compute the index of refraction of the line which has been found to

have the same index as the line *D*, for instance, of the liquid examined. This is easily done when the line in question has been identified by means of Kirchhoff's char, so that its wave-length is known. It will, of course, often happen that no line in the comparison-liquid exactly corresponds with the line *D* selected for the liquid examined. In this case the index of the nearest line may be employed instead, when great accuracy is not required and when subsidiary prisms are used, or we may use a filar micrometer, and interpolate so as to obtain the index of a coincident line by measuring the distance of the relative line *D* from one or more visible lines in the comparison-spectrum. The eye-piece micrometer suggested by Professor Rood* would also give all necessary precision, and would have the advantage of being very much cheaper than a filar micrometer.

The method above given enables us to determine the index of refraction of a single line only, unless the prism is emptied, cleaned, dried, and the operation then repeated with a second selected line. To obviate this difficulty, I have employed the following modification of the prism with entire success. The prism is divided into two by a septum perpendicular to its refracting edge. Each prism thus formed has an opening in its base by which liquid may be introduced or removed, and which can be closed with a cork. When the two glass plates are carefully cemented to the brass frame, the two prisms will have the same refracting angle. One of them is then to be filled with the comparison-liquid, the other with the liquid the indices of which are to be determined. The double prism being now placed upon the stage of the spectroscope, one face of the prism containing the comparison-liquid is to be covered with a slip of metal. The spectrum of the liquid to be examined will then be seen by means of the observing telescope. Any line—as, for instance, *C*—may then be selected, brought into the position of minimum deviation, and the telescope adjusted until this line bisects the space between the parallel wires in the plane of the diaphragm of the eye-piece. The telescope is then to be clamped as before without disturbing the adjustment. If now one face of the prism containing the liquid examined be covered with the slip of metal removed from the face of the other prism, the spectrum of the comparison-liquid will be seen, and it will be easy to determine what line in this spectrum most nearly corresponds in position to the line *C* of the other spectrum. By alternately covering the faces of the two prisms with the metal slip, coincidences, or near coincidences, may be observed for *D*, *E*, *F*, &c.; and in this manner the data obtained for the constants in Cauchy's dispersion formula for the liquid examined, in a short time and with great facility. It must be borne in mind that the two spectra in this process cannot be seen simultaneously, their images being combined by the observing telescope into one.†

In applying the above methods, I have used prisms with brass frames, and have cemented the glass plates either with common or marine glue, the latter being employed for aqueous solutions. Good workmanship would, doubtless, make it possible to fit the plates to the sides of the prisms so that they could be held in their places by springs, the prisms being perfectly tight; but I have not found this to be the case with prisms from German workshops which I have examined.

The process which I have given above furnishes, of course, a new application of the spectroscope to quantitative chemical analysis—all the results obtained by Landolt with the spectrometer being obtained with the spectroscope alone; but it is hardly necessary to say that a good spectrometer is an instrument greatly to be preferred, since it may be used also as a spectroscope, and since direct methods are always better than those of comparison.—*Proceedings of the American Academy of Arts and Sciences.*

* *Am. Journ. Sci.*, 3rd series, vol. vi., p. 44.

† Mr. S. P. Sharpley has suggested to me that, if a cylindrical were employed as the object-glass of the observing telescope, the spectra could be seen in the field at the same time.

ON A

DEPOSIT OF GYPSUM IN SOUTHERN UTAH.

By ALEX. T. MACHATTIE, Ph.D., F.C.S., Glasgow.

ON the road from Salt Lake City to the southern portion of Utah, one of the places at which the mail-coaches change horses is White Mountain, where, near the road, there is a large mound, of an almost pure white colour, from which, I presume, the place derives its name. The mound from a distance looks like a huge heap of white sand drifted into its present position by the wind, and lies in a valley or basin partly surrounded by low hills. On examination I found it to consist of small white—or almost white—particles, about the size of ordinary sea-sand, these being kept together by a covering of scanty vegetation. On analysis I found the following to be the composition of the powder:—

| | |
|--|--------|
| Water | 20.05 |
| Calcium sulphate | 75.39 |
| Calcium carbonate | 3.53 |
| Magnesium carbonate | traces |
| Siliceous matter | 0.90 |
| Loss, with very slight trace of organic matter | 0.13 |
| | 100.00 |

The amount of water required to convert 75.39 of anhydrous calcium sulphate into gypsum being 19.85, it is evident, from the above analysis, that the mound consists practically of gypsum containing a notable amount of calcium carbonate. The powder under the microscope is seen to consist of small water-worn particles of the gypsum in the fibrous form. The presence of so considerable a proportion of carbonate of lime in the gypsum, and, more particularly, the peculiar position and mechanical condition of such a large mound of that mineral, seem to me worthy of note.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.*

By H. CARRINGTON BOLTON.

BOERHAAVE, HERMAN. *Elementa Chemicæ*. Paris, 1724.

Also an English translation as follows:—"A new Method of Chemistry, including the theory and practice of that art laid down on mechanical principles and accommodated to the uses of life. * * * To which is prefixed a Critical History of Chemistry and Chemists from the origin of the art to the present time. Written by the very learned H. Boerhaave. * * * Translated by P. Shaw, M.D., and E. Chambers." 4to. London, 1727.

A logically arranged, condensed history of chemistry, forming the introduction to a very remarkable work of one of the most distinguished men of the time. (Boerhaave, born 1668, died 1738).

DU FRESNOY, LENGLET. *Histoire de la Philosophie Hermétique. Accompagné d'un Catalogue raisonné des Ecrivains de cette Science. Avec le véritable Philalèthe, revu sur les originaux*. 3 vols. 12mo. Paris, 1742.

The author of this exceedingly curious work was an Abbé of some distinction as a *littérateur*. He was born in 1674, and died in 1755. While apparently accepting the truth of the legends relating to the great antiquity of alchemy, and narrating accounts of veritable transmutations at considerable length, he at the same time exposes the frauds practised by the adepts, and quotes entire the celebrated essay of Geoffroy: "Des Supercheries concer-

nant la Pierre Philosophale," which rang the death knell of the Hermetic art.

The first volume of Du Fresnoy's work contains only historical matter, concluding with a "Chronologie des plus célèbres auteurs de la philosophie hermétique." In this chronology, which begins with "Hermes, 1996 B.C.," he includes Moses, Cleopatra, and Caligula, adepts being marked by an asterisk. The second volume continues the history, and includes the "Introitus apertus ad oclusum regis palatium" of Philalethes, entire, both in French and in Latin. The third volume consists of a compendious Bibliography of Chemistry embracing the works of a thousand authors.

SCHRÖDER, FR. JOS. WILH. *Geschichte der ältesten Chemie und Philosophie*. 8vo. Marburg, 1775.

Schröder was Professor of Chemistry and Medicine at the University of Marburg. This work is written in defence of the "Higher Chemistry," a term applied to alchemy by Wenzel, shortly before.

WIEGLEB, J. C. *Historisch-kritische Untersuchung der Alchemie oder der eingebildeten Goldmacherkunst*. 8vo. Weimar, 1777.

A severe criticism on the claims of hermetical philosophy.

BERGMAN, TORBERN. *De primordiis Chemicæ*. Upsala, 1779.

BERGMAN, TORBERN. *Historiæ chemicæ medium seu obscurum ævum*. Upsala, 1782.

Bergman, born 1735, died 1784, was Professor of Chemistry at the University of Upsala. The above essays were presented to the Academy of Sciences in Stockholm.

BAUMER, J. W. *Bibliotheca Chemicæ*. Giessen. 8vo. 1782.

WIEGLEB, J. C. *Geschichte des Wachstums und der Erfindungen in der neuern Zeit*. 2 vols. 8vo. Berlin, 1790.

This covers the period from 1650 to 1790; the matter is chronologically arranged.

WIEGLEB, J. C. *Geschichte des Wachstums und der Erfindungen in der Chemie in den ältesten und mittleren Zeiten*. 8vo. Berlin, 1792.

This is a translation of Bergman's works above mentioned.

BECKMANN, JOHANN. *Beiträge zur Geschichte der Erfindungen*. 5 vols. 8vo. Leipzig, 1780—1805.

GMELIN, J. F. *Geschichte der Chemie seit dem Wiederaufheben der Wissenschaften bis an das Ende des 18 Jahrhunderts*. 3 vols. 8vo. Göttingen, 1797.

An unwieldy work, with a stupendous amount of detail, badly arranged. It excels in bibliographical references.

REUSS, J. D. *Repertorium Commentationum a Societatibus litterariis editarum secundum disciplinarum ordinem digessit J. D. Reuss*. 4to. Göttingæ, 1803. (Scientia Naturalis. Chemicæ, &c. Vol. III.)

An exceedingly useful work, compiled with great diligence. Comprises sixteen volumes, of which the third volume of the division of natural science is devoted to chemistry and metallurgy. The whole work forms a proper introduction to the "Catalogue of Scientific Papers" published by the Royal Society, which covers the years 1800 to 1863.

JOHNSON, ———. *History of the Progress of Animal Chemistry*. 3 vols. London, 1803.

FUCHS, G. FR. CHR. *Repertorium der chemischen Literatur von 494 vor Christi Geburt bis 1806, in chronologischer Ordnung aufgestellt*. 8vo. Jena und Leipzig, 1806-12.

* From the *Annals of the Lyceum of Natural History*, N. Y., vol. x.

This work is highly praised by Petzholdt, as exceedingly compendious and carefully prepared. It contains not only independent works, but also articles from periodical literature, to which are added numerous biographical and literary notes. Actually, it extends only to 1799, inclusive; the proposed third volume (1800 to 1806) never appeared.

BARRETT, FR. *The Lives of Alchemistical Philosophers; with a critical catalogue of books in occult chemistry and a selection of the most celebrated treatises on the theory and practice of the Hermetic Art.* 8vo. London, 1815.

Contains superficial biographies of 45 so-called adepts, a list of 750 alchemical books, and selections from the most incredible treatises on the hermetic art. Bibliographically it is very inexact.

DAVY, SIR HUMPHRY. *Historical View of the Progress of Chemistry, in Davy's Collected Works.* Vol. IV. London, 1829.

A brief sketch.

THOMSON, THOMAS. *A History of Chemistry.* 2 vols. 12mo. London, 1830.

A very entertaining and useful work, embracing the whole field up to the date of publication. The progress of analytical chemistry is reviewed with critical skill.

CALLISEN, A. C. P. *Medicinisches Schriftsteller Lexicon der jetzt lebenden Aerzte, Wundärzte, Geburtshelfer, Apotheker und Naturforscher* * * 33 vols. 12mo. Kopenhagen, 1830—1845.

A wonderfully exhaustive and laborious compilation, replete with minutest details concerning the literature of medicine and natural science. Chemistry proper, though not included in the title of the work, receives its full quota of attention. The author sacrificed a fortune in compiling and publishing these numerous and closely printed volumes.

SCHMIEDER, KARL CHRISTOPH. *Geschichte der Alchemie.* 8vo. Halle, 1832.

Schmieder was born at Eisleben, in 1778, and was Director of a High School and School Inspector in Cassel, at which place he died in 1850. Several minor works on geology and mineralogy appeared from his pen, but none of such extraordinary character as this History of Alchemy, in which he endeavours to establish, by historic proofs, the reality of the transmutation of metals. Schmieder recognises two distinct sciences, chemistry and alchemy, and claims they exist independently of each other from the earliest ages. Alchemy, he states, has a threefold dogma.—1. It is possible to prepare, by true art, perfect gold from substances which contain no gold. 2. The same is true of silver. 3. This artificial preparation is a wonderful medicine, a panacea of life. Starting with this statement he investigates the authenticity of the historic records of transmutation, and sparing no pains in deciphering musty manuscripts of a former age, he concludes that we must acknowledge the reality of the transmutation of metals. He confesses that impostors abounded, but thinks he establishes the claims of five persons as true adepts, and gives their personal history with narratives of their wonderful accomplishments. He calls attention to the fact that the five persons named lived at succeeding periods and concludes that the Philosopher's Stone was secretly handed down from one to the other.

The whole aim and scope of this strange work, and especially the conclusions drawn, seem more appropriate to the times of Borrichius than to the second quarter of the enlightened 19th century.

HOEFER, FERDINAND. *Histoire de la Chimie.* 2 vols. 8vo. Paris, 1842. (Second edition in 1866).

A work of great research, especially in regard to earliest authentic records as derived from ancient manuscripts.

KOPP, HERMANN. *Geschichte der Chemie.* 4 vols. 8vo. Braunschweig, 1843.

A classical work, above praise. Is somewhat scarce; a new edition in Roman type is desirable.

WOLFF, EMIL THEODOR. *Quellen-Literatur der theoretisch-organischen Chemie oder Verzeichniss der vom Anfang des letzten Viertels des vorigen Jahrhunderts bis zum Schluss des Jahres 1844 ausgeführten chemischen Untersuchungen.* * * * 8vo. Halle, 1845.

A carefully collated index to the researches in organic chemistry within the period named.

WOLFF, EMIL THEODOR. *Vollständige Uebersicht der elementar analytischen Untersuchungen organischer Substanzen.* * * * *Aus den chemischen Journalen* * * * *in systematischer Ordnung entworfen.* 8vo. Halle, 1846.

WAGNER, RUDOLF. *Die Geschichte der Chemie. Von der Kindheit des Menschengeschlechts bis auf unsere Tage.* 8vo. Leipzig, 1853.

FIGUIER, LOUIS. *L'Alchimie et les Alchimistes. Essai historique et critique sur la philosophie hermétique.* 12mo. Paris, 1855.

A readable work, founded mainly on Schmieder's *Geschichte der Alchemie*.

POPPE, ADOLPH. *Chronologische Uebersicht der Erfindungen und Entdeckungen auf dem Gebiete der Physik, Chemie, Astronomie, Mechanik und industriellen Technik von den ältesten Zeiten bis auf unsere Tage.* 8vo. Frankfurt, 1856.

ZUCHOLD, ERNST AMANDUS. *Bibliotheca Chemica. Verzeichniss der auf dem Gebiete der reinen pharmaceutischen physiologischen und technischen Chemie in den Jahren 1840, bis mitte 1858 in Deutschland und im Auslande erschienenen Schriften.* 8vo. Göttingen, 1859.

A most complete contribution to special bibliography. All the works bearing chemistry in their title, or relating to the subject, issued between the years named, in twenty-one different languages, are here alphabetically arranged. A sequel for the years 1858—70 was issued by Ruprecht in 1872.

WURTZ, ADOLPHE. *Sur quelques Points de Philosophie Chimique. Lecons professées les 6 et 20 Mars 1863, devant la Société Chimique [de Paris] par M. Adolphe Wurtz, Président de la Société.* 8vo. Paris, 1864.

An admirable discussion of the development and principles of modern chemical philosophy.

DEHERAIN, P. P. *Etudes pour servir à l'histoire de la Chimie [Extrait des Annales du Conservatoire impérial des arts et métiers].* 8vo. Paris, 1864.

SILVESTRI, ORAZIO. *Il presente ed il passato della chimica considerata nei suoi rapporti con le altre scienze naturali.* 16mo. Catania, 1864.

(To be continued.)

Reduction of Aldehyds to Alcohols.—Carl Schorlemmer.—The author dissolves cœnanthic aldehyd in strong acetic acid, and adds gradually to the cooled solution liquid sodium-amalgam, until a deposit of acetate of soda took place. A sufficiency of water was added, the lighter stratum of liquid which rose to the surface was removed, again dissolved in acetic acid and treated with amalgam, till the pungent odour of cœnanthic oil was no longer perceptible. The crude product, which evidently contained acetate of heptyl, was left for a time in contact with caustic potash, and then distilled. The distillate was dehydrated as far as possible with ignited potash and repeatedly rectified over small quantities of sodium. A good yield of pure heptylic alcohol was thus obtained.—*Liebig's Annalen*.

SOCIETY OF PUBLIC ANALYSTS.

THE SALE OF FOOD AND DRUGS BILL.

ON May 28th last, this Bill having passed its third reading in the House of Commons, we reprinted its more important clauses and italicised the very numerous alterations which they had undergone in the passage of the Bill through its various stages in the Lower House.

More than two months have elapsed, and we are approaching the end of the session, and still the Bill has not become an Act of Parliament.

The House of Lords have, however, considerably amended it, and their alterations, which it is only fair to admit bear the mark of thoughtful consideration, have been agreed to, all save one, by the Commons.

It is therefore only this one, concerning clause 6, which stops the way.

The measure having arrived so nearly at completion, we will briefly direct attention to the amendments to which both Lords and Commons have agreed.

In clauses 3 and 4 the word "knowingly" is struck out, and thus at last this obnoxious word has no place in the Bill at all. However, to prevent any injustice being done to an honest and reasonably careful tradesman, the following is introduced as an addendum to clause 4:—

Provided that no person shall be liable to be convicted under either of the two last foregoing sections of this Act in respect of the sale of any article of food, or of any drug, if he shows to the satisfaction of the justice or court before whom he is charged that he did not know of the article of food or drug sold by him being so mixed, coloured, stained, or powdered, as in either of those sections mentioned, and that he could not with reasonable diligence have obtained that knowledge.

Clause 5, which has given rise to so much discussion, has been again recast, and now stands—

No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds; provided that an offence shall not be deemed to be committed under this section in the following cases; that is to say,

- (1). Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof;
- (2). Where the drug or food is a proprietary medicine, or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;
- (3). Where the food or drug is compounded as in this Act mentioned;
- (4). Where the food or drug is unavoidably mixed with some extraneous matter in the process of collection or preparation.

Clause 7 is made a shade more stringent by providing that the admixture allowable in the presence of a label shall not only be "not intended fraudulently to increase its bulk, weight, or measure," but must not be intended to "conceal the inferior quality" of the article. There are some minor alterations in this clause to which it is needless to refer.

In clause 11 it was already provided that "any purchaser" might, if there were no analyst appointed for the district in which the purchase was made, take the article "to the analyst of another place," but in clause 12, referring to the action of "medical officers, inspectors, &c.," no provision was made for the analysis of

any articles purchased by them except by "the analyst of the district."

This is now amended, and where there is no appointed analyst, any inspector, &c., may take samples to the "analyst of another place," and "such analyst shall, upon receiving payment as is provided in the last section (*i.e.*, by special arrangement), analyse the same," &c.

In clause 18, which refers to the analysts' quarterly reports, the word "presented" is substituted for "read." This alteration bears this significance, that hitherto it has been imperative for the report to be "read," and consequently if an analyst had to deal with a stupid or a prejudiced Board, he was not entirely at their mercy, inasmuch as it was out of their power to strangle his report by merely ordering it to be "laid on the table."

This, it appears, they can now do, but there is this compensating advantage, that every such local authority is now bound to transmit annually to the Local Government Board, *not* a copy "of the number of articles analysed," but of "*such quarterly report.*"

In clause 21 is an important addition.

It was therein provided that "the justices before whom any complaint may be made," might send an article to be analysed to Somerset House, but no such power was given in any case of appeal. This was manifestly an omission, which is now supplied, and the same power is given to "the court before whom any appeal may be heard."

The phraseology of clause 24 has been remodelled to suit their lordships, but as the sense remains substantially the same, that is of little consequence.

The following addendum to clause 27 is of immense importance to the retailer who has been treated unfairly by the wholesale dealer who has supplied him, and deserves to be carefully read by all, if only to illustrate the painstaking care which the House of Lords have given to the Bill.

"Provided that in any action brought by any person for a breach of contract on the sale of any article of food or of any drug, such person may recover alone or in addition to any other damages recoverable by him the amount of any penalty in which he may have been convicted under this Act, together with the costs paid by him upon such conviction, and those incurred by him in and about his defence thereto, if he prove that the article or drug the subject of such conviction was sold to him as and for an article or drug of the same nature, substance, and quality as that which was demanded of him, and that he purchased it not knowing it to be otherwise, and afterwards sold it in the same state in which he purchased it; the defendant in such action being nevertheless at liberty to prove that the conviction was wrongful, or that the amount of costs awarded or claimed was unreasonable."

There are numerous other amendments to which both houses have agreed, but as they are of scant interest to analysts, and as it may reasonably be hoped that the Act itself will be published ere long, we do not propose to allude to them here.

It therefore only remains for us to refer to the one clause (6) upon which the two houses are at variance. The clause, as it left the House of Commons, is before our readers.

The Lords proposed to cut it down to the following dimensions:—"No person shall sell any compound article of food or compounded drug which is not composed of ingredients in accordance with the demand of the purchaser, under a penalty of twenty pounds."

To this the Lower House object, and submit as an alternative proposal, the following, which is substantially a restoration of the clause to its original form:—

"No person shall sell any compound article of food or compounded drug which is not compounded of ingredients in accordance with the demand of the purchaser, or in the case of a drug which is not compounded in accordance with the prescription presented by the purchaser, or with

the prescription of a registered medical practitioner, or with the regulations prescribed by the British Pharmacopœia issued by the General Medical Council, or in Great Britain with a basis to be laid down by the Council of Pharmaceutical Society of Great Britain, or the Privy Council, or in accordance with the provisions of the Pharmacy Act, 1868, or in Ireland in accordance with the Act of the session of the thirty-third and thirty-fourth of Victoria, chapter twenty-six, under a penalty not exceeding twenty pounds."

The Peers, however, on the motion of the Duke of Richmond, on the 3rd instant, decided to "disagree" to the Commons' amendment, and have appointed a Committee to draw up reasons for their disagreement; and so at present the matter stands, and whichever House eventually gives way one reflection will occur to all anxious to see the Bill become Law, in view of the speedy termination of the Session, that, whatever is to be done, "'t were well 't were done quickly."

We have now laid before our readers all the changes of any moment made in the Bill up to the present date, and these read side by side with the abstract (CHEMICAL NEWS, vol. xxxi., p. 235) will enable them to see exactly what the Bill is: they will therefore be able to form their own conclusions as to its value, or otherwise, for the purpose for which it is intended.

Any opinions of our own we will reserve for a future occasion, when we hope we may be able to speak of the measure as an accomplished fact.

NOTICES OF BOOKS.

Pyrology, or Fire Chemistry. By W. A. Ross. London: E. and F. N. Spon.

OUR readers will remember that in 1868 there appeared in the CHEMICAL NEWS a series of papers on Blowpipe Analysis, by Major Ross, at that time a resident in India. These articles form the nucleus of the present volume,—a work which we have no hesitation in pronouncing original and valuable. The author, as will at once be evident, is not a chemist trained in the orthodox school, outside of which there is no salvation. For cooked results and unproved theories he shows very little respect, and if he were brought up for examination at South Kensington we fear his "passing" would be by no means a matter of certainty. But this lack of normal chemical discipline, if it occasionally betrays him into errors, is far from being an unmixed source of weakness. It is an advantage to the world of science occasionally to hear the observations of one who approaches his subject by an unwonted route, and who, therefore sees it from a novel point of view. It is evident that the author is a careful, laborious, and patient experimentalist, and that he has a fruitful and suggestive mind. Now, in our humble opinion, the man who can originate even the smallest addition to our stock of knowledge is vastly superior to the "walking encyclopædia."

In his preface, the author questions the alleged simplicity of the supposed elementary bodies. In this view he is, it must be admitted, supported by the general tendency of modern science. Does it not seem, to say the least, highly probable that the doctrine of Evolution applies to chemical no less than to zoological species? He considers hydrogen as the principle of all metals, which, he adds, would furnish "a new and most interesting key with which to attempt to unlock the yet unexplained secrets of electricity, magnetism, and some spectral phenomena." He calls in question the accuracy of certain atomic weights, pointing out that such elements as cerium and didymium have never been perfectly isolated.

Incidentally he denounces the patent-laws, remarking that had he "lived under any other than the English patent law, which recognises unprincipled improvements

rather than original inventions," he would have patented the practical applications of certain of his discoveries. But how if he had lived in Holland or Switzerland, which grant no patents at all; or in Germany, where the case is substantially little better, and where the adoption of the English system—with all its admitted defects—is craved by inventors?

The main subject of the work—"pyrology," or "fire-chemistry"—is somewhat wider than what is ordinarily understood by blowpipe analysis. It may be considered as the minute study of chemical reactions produced in the "dry way." It can scarcely, we think, be disputed that this mode of research and this phase of chemistry have been too much overlooked, and that we have almost exclusively taken into account reactions obtained in the "wet way." The recent revelations obtained by the spectroscope are leading many chemists to question the propriety of this one-sidedness.

Our author gives, as Introduction, an interesting survey of the history of blowpipe analysis. He is, however, in error in supposing that since the time of Wollaston little or nothing has been done in England to improve or develop this mode of chemical research. In the CHEMICAL NEWS for instance, may be found certain original communications on this subject, by Mr. David Forbes, which we feel sure Major Ross would not pronounce valueless.

In a subsequent portion of the work the author remarks that the volatility of silver at high temperatures is not unknown in Germany. We can assure him that among assayers and metallurgists it is not unknown in England also. It is, however, remarkable how long a fact may remain in the hands of some particular class of practical men before it is recognised in standard works. For instance, potash and soda rejoice in the name of fixed alkalies; yet all soap-makers know that their lyes give off a well-marked odour by which they can be at once distinguished from solutions of the corresponding carbonates. Books tell us that carbonate of soda cannot be, like carbonate of lime, decomposed by heat; yet it is well known in alkali-works that soda-ash, heated too strongly or too long, loses a portion of its carbonic acid, and is partially causticised.

Among the principal improvements of which Major Ross claims the authorship are—the use of aluminium for supports in testing with the blowpipe, the vesiculation of borax with oxides dissolved in it, the vesiculation of boric acid, and the use of phosphoric acid as a reagent under novel circumstances.

It is obviously impossible for us to enter into an examination of all the author's methods and procedures; but we can imagine few courses of research more beneficial for a young chemist than to take up this work, and go carefully through the experiments laid down, and a few at least of the multitudinous collateral issues which they evidently raise. The least merit which belongs to Major Ross is that he has extended and improved the value of the blowpipe as a means of chemical and mineralogical research: possibly it may be found that he has done much more.

As an instance of the valuable facts which the author brings forward incidentally, we may take the following, which surely will be found of interest not in scientific circles alone:—"The *soi disant* mortar taken by myself from between the bricks of the Agra Barrack was supplied by a native contractor to the Department of Public Works of the Indian Government, and is made—or said to be made—from the Kunkur, with which the whole district abounds. The reactions show that this substance is little better than mud, with a small quantity (perhaps 8 or 9 per cent) of lime and magnesia. The costly building from which this composition was taken is not yet one of the many Indian public buildings which have been ordered to be "abandoned" by the Government, lest they should fall on the heads of troops and others, some having actually fallen, and one at Allahabad—from the mortar of which just 5 per cent of lime was obtained by a Calcutta chemist, at

the request of the late Lord Mayo—fell and killed five or six people. It has been publicly stated in India, without denial, that the Indian Government has lost £40,000,000 by abandoned or ruined public buildings built of Kunkur mortar in the last ten years, though, on the other hand, it appears to produce a fair hydraulic cement." Would not our authorities find that to obtain good chemical advice—we do not mean *gratuitously*, as they sometimes attempt—would be the truest economy?

We can strongly recommend this book to analysts, assayers, mineralogists, and to all persons interested in mining and metallurgy; and we trust the author will feel encouraged to persevere in researches which must ultimately prove fruitful.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAS. BRAITHWAITE, M.D. Vol. lxxi., Jan.—June, 1875. London: Simpkin, Marshall, and Co.

THIS half-yearly repertory, invaluable as it must be to the medical profession, contains but little matter of a strictly chemical nature. We find iodic acid recommended as a very delicate colour test for the presence of strychnia. When a saturated solution of iodic acid is gently warmed in contact with strychnia a pink-rose tint is evolved, which lasts for an hour or more, and gradually fades out through flesh-colour to a fawn.

Molybdic acid dissolved in pure sulphuric acid is proposed as a test for opium. It forms in contact with any liquid in which morphia is present a deep maroon colour, which after a time becomes a deep purple, and then changes first to a darker and ultimately to a bright blue. This blue colour remains perceptible for some hours before it fades away. The reaction is distinct with a single drop of the pharmacopœial tinct. opii. The reagent is most sensitive when freshly prepared; still two months after it was made it enabled Dr. Southey to detect the $\frac{1}{10}$ th of a grain of morphia.

In an interesting paper Dr. Odling contends that the so-called malarial diseases are due not to any specific poison, but to cold or chill after exposure to great heat, especially if it has been accompanied with severe fatigue.

Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. By G. J. BRUSH. New York: John Wiley and Sons. London: Trübner and Co.

THIS book consists of two portions. The former portion treats on blowpipe analysis, and is avowedly based on the works of Berzelius and Plattner. As such we need scarcely say that the methods laid down for the determination of minerals are excellent. When we remember, however, that there are at least three revisions of Prof. Plattner's great work in the English language, one of which—that by Prof. H. B. Cornwall—leaves scarcely anything to desire, we cannot help feeling somewhat doubtful as to the *raison d'être* of this section of the work before us.

The second portion of Mr. Brush's book is a translation of von Kobell's well known *Tafeln zur Bestimmung der Mineralien*, with the addition of new species, and of alterations in form, which the author hopes will greatly facilitate the work of the student.

The appearance of the work is a fresh proof, if such is needed, of the great and increasing attention given in the United States to mineralogy.

Bulletin of the Bussey Institution. Part III., 1874. Cambridge: J. Wilson and Son.

THIS issue contains three interesting articles, all from the pen of Professor F. H. Storer. The first of these treats on the valuation of the soluble phosphoric acid in superphosphate. This the author fixes at somewhat under 12½ cents gold per lb., a point rather below the English standard. It is, indeed, becoming somewhat doubtful

whether the chemist has, strictly speaking, anything whatever to do with the valuation of manures. If there is only one standard of value—the purely commercial depending, of course, on supply and demand—we should pronounce that he has not. But it has been generally considered that there exists also a second standard of value totally unaffected by supply and demand, and depending on its power to nourish vegetation. This second ought to be higher than the commercial value; and it is with the former alone that the chemist can concern himself. The paper on the "Average Amount of Potash and Phosphoric Acid in Wood Ashes" will have a permanent value as containing very copious and carefully compiled tables of the saline constituents of woods, barks, leaves, &c.

In the paper on the "Importance as Plant-Food of the Nitrogen in Vegetable Mould," Professor Storer comes to the conclusion that, "for the present support of agricultural crops, the vast stores of vegetable mould that have accumulated in the soil through the decay of many generations of plants, constitute a more abundant and a more important source of nitrogenised plant-food than any other."

CORRESPONDENCE.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—While there is so much discussion going on in your columns in regard to the analysis of milk and the punishment of vendors (sometimes by very trivial fines—*vide* CHEMICAL NEWS, vol. xxxii., p. 7), you may be willing to print the result of three recent complaints made by the Milk Inspector here, who bases his action upon my analysis. Bills were found by the grand jury against three milk vendors, and, each pleading guilty, two were fined 300 dollars and costs apiece (say, £60), and the third, for a first offence, 30 dollars and costs, or about £6 sterling. The percentages of solids not fat were, respectively, 6.35, 6.57, and 7.0.—I am, &c.,

J. M. MERRICK.

59, Broad Street, Boston, Mass., U.S.A.,
July 17, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 1, July 5, 1875.

Distribution of Magnetism in Bundles of Infinite Length Composed of very Slender Laminæ.—M. J. Jamin.—It is demonstrated that, in superposing laminæ in any number and in any direction, the bundle contains the algebraic sum of the magnetisms of its elements; but this is only true when the bundle is so long that it may be considered infinite.

Second Note on Tubular Electro-Magnets with Multiple Nuclei.—Th. du Moncel.—Not adapted for abstraction.

Protosulphide of Carbon.—M. Sidot.—The author makes known the continuation of his researches on the decomposition of bisulphide of carbon under the influence of solar light. In a memoir presented to the Academy, January 15, 1872, he mentioned that the bisulphide of

carbon was decomposed on exposure to light, giving rise to a gas, and a red flocculent matter. On collecting a larger quantity of these products, he finds the gas to be merely air; and on taking due precautions to prevent its entrance into the apparatus, he effected the decomposition of sulphide of carbon without the production of a gas, obtaining sulphur, which remained in solution, and a brown matter, which was precipitated. The process was conducted in U-tubes, of 1 metre in length by 0.015 metre in diameter, one of the limbs being surmounted by a capillary delivery tube, and the other by a straight gas tube, both closed at the lamp. The light was allowed to act upon these tubes for about two months. At the end of this time the operation seemed terminated, the action of the light becoming more feeble as the layer of matter became thicker. The liquid contained in the tubes was filtered, and then distilled, when there remained in the retort crystalline sulphur, coloured a reddish brown by a little dissolved protosulphide. As for the precipitated matter, it remained attached to the interior of the tubes, from which it was removed by washing with distilled water. The weight of this matter, when purified, is to that of the residual sulphur as 3 to 4, that is to say, in the ratio of 1 equivalent sulphur to 1 equivalent of protosulphide of carbon. On analysis it was found that this compound is really the protosulphide, SC, resulting from the dissociation of CS₂ into CS and S. The protosulphide of carbon is a maroon powder, tasteless, and inodorous. Its specific gravity is 1.66. It is insoluble in water and alcohol, oil of turpentine, and benzol. In bisulphide of carbon and ether, both at a boil, it dissolves in very small quantities. Boiling nitric acid dissolves it, and turns red; the monohydrated acid poured upon the protosulphide of carbon in a stoppered tube, ignites it, and takes a deep brown colour. Sulphuric and hydrochloric acid do not appear to attack it. Potash, concentrated and boiling, dissolves it with a black-brown colour, but if the solution is neutralised with an acid the liquid is decolourised, and the protosulphide is liberated in flocks. If heated to about 200°, it begins to decompose into sulphur, which escapes, and carbon, which remains. In this decomposition there is always produced a little bisulphide resulting from the reaction of the liberated sulphur upon undecomposed portions of protosulphide. On heating protosulphide with excess of sulphur the synthesis of the bisulphide was effected. The author is studying the compounds resulting from the action of chlorine, bromine, and iodine upon the protosulphide of carbon.

Processes of Magnetisation.—J. M. Gaugain.—The author arrives at the general conclusion that if the angle formed by the magnet and the bar is made to vary from zero to 180° the magnetisation increases with the size of the angle. This law, however, does not hold good when the angle formed by the magnet and the bar exceeds 90°. It then decreases till a certain limit has been passed, which, in the author's experiments, was near 120°.

Nuts of Bancoul.—M. B. Corenwinder.—This nut is the seed of a tree belonging to the *Euphorbiaceæ*, of which two or three species occur in Ceylon, Cochin-China, New Caledonia, Bourbon, &c. It is composed of a hard and woody endocarp, and of an oily kernel, containing—

| | |
|-----------------------------|--------|
| Water | 5.000 |
| Oil | 62.175 |
| Nitrogenous matter .. . | 22.653 |
| Non-nitrogenous matter .. . | 6.827 |
| Mineral matter | 3.345 |

100.000

Nitrogen 3.625 per cent.

The cake, after expression of the oil, contains 9 per cent of nitrogen and 4 per cent of phosphoric acid, and is consequently of high value as a manure. The expressed oil is purgative, but as a lamp-oil it is superior to colza. Unfortunately the kernel forms only 33 per cent of the entire weight of the nut. Hence, before it can become

an article of commerce, it must be decorticated at the place of its growth.

Gum of Wine, and its Influence upon the Determination of Glucose.—M. G. Chancel.—For a considerable time it has been known that, besides glucose, wine contains other substances, optically active, and capable of reducing the cupro-potassic reagent. M. Pasteur, ten years ago, extracted from wine a substance which he described as a kind of gum. Recently Béchamp (*Comptes Rendus*, lxxx., p. 967) announced that he had isolated two bodies, A and B, capable of reducing the reagent of Frommherz. The author considers that the gum of M. Pasteur is identical with the substance A of M. Béchamp, and with the reducing substance of Neubauer, Hoppe-Seyler, Schubert, &c.

Chlorobromated Ethylen: Isomerism of its Chloride with the Bromide of Perchlorated Ethylen.—M. E. Bourgoin.—On causing chlorine to react upon the perbromide of acetylen the author has discovered a crystalline body, which he proposes to call chloride of chloro-bromated ethylen. It has the same composition as the bromide of chlorethos or the bromide of perchlorated ethylen. The author considers these compounds as isomeric, not identical, and represents the composition of the bromide of chlorethos by C₄Cl₄(Br₂)

Justus Liebig's Annalen der Chemie,
June 25, 1875.

Determination of Phosphorous Acid, and on the Composition of the Phosphite of Baryta.—A. Prinzhorn and H. Precht.—Communicated by K. Kraut.—Phosphorous acid can be very conveniently and accurately determined by means of mercuric chloride. The phosphite is dissolved in hydrochloric acid, an excess of the chloride is added, and the whole is heated in the water-bath till mercurous chloride is rapidly and completely deposited, for which about two hours are requisite. When the filtrate no longer becomes turbid, even at a full boil over the open flame, the deposit is collected upon a tared filter, dried at 100°, and weighed. If the filtrate is then freed from mercury by the passage of sulphuretted hydrogen, and from other bases which interfere with the determination of phosphoric acid, the latter may be thrown down with magnesia-mixture, thus furnishing a way of checking the result. The authors are engaged with an investigation of the phosphites.

Decomposition of Certain Compounds of the Aromatic Series by Chlorate of Potash and Hydrochloric Acid.—Dr. Jos. Schreder.—The author examines the action of this mixture upon gallic acid, salicylic acid, and phenol, and finds among the results iso-tri-chlor-glyceric acid, a circumstance evidently connected with the very interesting fact observed by Linnemann and Zotta, that under certain circumstances glycerin can be converted into phenol.*

Improved Forms of Water-Air Pumps.—Edouard Linnemann.—This important paper is not intelligible without the accompanying illustrations.

Grove's Method of Preparing Chloride of Ethyl and its Homologues.—C. Schorlemmer.—The excellent method of preparing the chlorides of ethyl and methyl is not suitable for obtaining their higher homologues.

Investigations on the Paraffins of Pennsylvanian Petroleum.—T. M. Morgan.—A translation of an inaugural dissertation for the Dalton scholarship, Owens College, Manchester.

Remarks on the foregoing Paper.—Carl Schorlemmer.—The author considers that Morgan's results do not necessarily prove the presence of three heptanes in petroleum.

* *Liebig's Annalen*, Supplement Band viii., 254.

Action of Mineral Acids upon Chloride of Lime.—Ferdinand Kopfer.—The author considers it simplest to regard hypochlorous acid as a direct product of the decomposition of chloride of lime by mineral acids. Either Gay-Lussac's hypothesis on the constitution of the bleaching constituent in chloride of lime must be accepted, or that of Odling, but to which the preference belongs he has not been able to determine.

On Arbutin.—H. Hlasiwetz and J. Habermann.—Not suited for abstraction.

Occurrence of Ethylic Alcohol or its Ethers in the Vegetable Kingdom.—Dr. H. Gutzeit.—This paper proves the occurrence of ethylic alcohol in unfermented vegetable juices, *i.e.*, those of the fruits of *Heracleum giganteum* and *Pastinaca sativa*. In the juice of a third plant, *Anthriscus cerifolium*, the existence of ethyl compounds is also demonstrated, but it is not yet decided whether such occur in the state of alcohol or of ethers.

Bulletin de la Societe Chimique de Paris,
No. 1, July 5, 1875.

Second Memoir on Albumen and Proteic Bodies.—M. Schützenberger.—The author examines the constitution of the amidised bodies corresponding to leucin and its homologues, the existence of which he had established in a former paper. (*Bul. Soc. Chim.*, tome xxiii., p. 161).

On Camphenes.—M. J. Ribau.

Isomerism of the Hydrochlorates, $C_{10}H_{16}HCl$.—M. J. Ribau.

Transformation of the Camphor of the Laurineæ into Camphene, and Reciprocally of Camphenes into Camphor.—M. J. Ribau.

New Method of Preparing Highly-Concentrated Formic Acid by means of Dehydrated Oxalic Acid, and of a Polyatomic Alcohol.—M. Lorin.

The above four papers have been already noticed.

Action of Chlorine upon Isobutyl-hydriodic Ether.—M. Prunier.—The substitution of chlorine in this compound appears to furnish a complete series of chlorinised bodies from C_8H_9Cl to $C_8H_4Cl_6$, $C_8H_2Cl_8$, and even beyond.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 9, July 1, 1875.

M. Moigno announces a work of his own under the title of "Faith and Science: Explosion of Free Thought in August and September, 1874: Annotated Discourses of MM. Tyndall, Du Bois-Reymond, Richard Owen, Huxley, Hooker, and Sir J. Lubbock." In his introductory remarks he terms himself the "advanced sentinel of truth," and states—"I have effected in myself the perfect conciliation of Faith and Science. I have studied more than all the champions of free thought. I have great confidence in the enlightenment which this modest work will produce."

The issue contains no chemical or physical matter which we have not already noticed.

No. 10, July 8, 1875.

Preservation of Meat in Compressed Air or Oxygen.—M. Moigno maintains that in this process M. Bert had been anticipated by Alvaro Reynoso.

Tempered Glass.—E. Girouard.—Articles of tempered glass sometimes burst into a multitude of fragments if struck very slightly. This happens chiefly when they have undergone a molecular modification by the action of a great number of previous shocks or blows. The author thinks that the process of tempering may be also applicable to enamel, earthenware, &c. (As regards the novelty of tempering glass, it is interesting to observe that it was customary in the north of England, in the last century, to place newly-purchased glasses, cups, &c., in a pan of cold water, which was then very gradually

raised to a boil, with the idea that they were thus rendered less brittle.)

Congelation of Water by Capillarity and Evaporation.—C. Decharme.—An account of experiments undertaken to freeze water by taking advantage of the volatility of bisulphide of carbon, ether, &c.

Seventh Bulletin of Osmose.—A paper on sugar refining.

Temperatures of Combustion in the Open Air.—H. Valerius.—A reply to a paper by M. Vicaire, contained in *Les Mondes* for May 20, on the exactitude of the law of Bunsen, according to which oxygen and combustible bodies can only combine in proportions which vary abruptly at certain changes of temperature.

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. iv.

On the Hydrate of Chlorine.—Ugo Schiff.—The compound $Cl_2 + 10H_2O$, in its property of hydrate of a chemical element, occupies an entirely special position in the chemical system. Gœpner has recently investigated this compound (*Berichte*, viii., p. 287), and cites U. Schiff as the author of the view which regards it as—



M. Schiff does not remember having ever published such a view, which is of a much more ancient date. He points out that hypochlorous acid is an explosive compound, whilst the hydrate in question shows no tendency of this kind, not even when thrown into concentrated sulphuric acid somewhat heated.

Action of Aniline upon Dichlorhydrin.—Ugo Schiff.—Already noticed.

Supposed Transformation of the Asparagin of the Leguminosæ into an Albumenoid.—M. Mercadante.—The author concludes that asparagin formed during the germination of seeds is decomposed, ammonia being especially found among the products of decomposition. It cannot be admitted that asparagin is transformed into albumenoids under the influence of light, and of carbonic acid. Light, instead of converting asparagin into albumen, decomposes it, yielding aspartic and succinic acids.

Tincture of Litmus.—F. Mohr.—To obtain a very sensitive tincture of litmus, the author super-saturates with sulphuric acid to decompose the carbonates, and then adds baryta-water until a blue colouration is produced—(*Zeitschrift für Analytische Chemie*).

Phosphate of Chrome.—H. Kaemmerer.—An alkaline solution of chromic oxide containing phosphoric acid, deposits chromic oxide on boiling.

New Naphthaline Colour.—M. Ballo.—On heating naphthylamin and bromide of naphthalin, there is produced a liquid mass of a dark red by transmitted light, which if extracted with ether leaves a blue powder soluble in alcohol with a fine violet colour, and is the hydrobromate of a base, precipitable by ammonia in blue flocks.—(*Dingler's Journal*).

Fascicolo v.

Oxidation of Sulphur.—Prof. Egidio Polacci.—The principal results of the author's researches are that moist sulphur exposed to the air under ordinary conditions of temperature, although not associated with any other material, is easily converted into sulphuric acid. This conversion, slowest at low temperatures, is accelerated at + 35 to 50°, and becomes rapid at + 65 to 70°. The addition to the sulphur of carbonate of lime, but not that of other earthy carbonates, facilitates the production of sulphuric acid. Hydro-sulphuric acid, mixed with moist air in presence of a porous body, and at a moderately elevated temperature, is slowly converted into sulphuric acid. Even dry sulphur, by the mere contact of the air, if the latter is not deprived of its watery vapour, gives rise to sulphuric acid. In this case the amount of sulphuric acid formed will be in proportion to the absorbent power of the sulphur.

MISCELLANEOUS.

Metallic Alloys.—We lately drew attention to the appointment of the United States Board for the purpose of testing iron, steel, and other metals. Prof. Thurston, the Chairman of the Committee on metallic alloys, has just issued a circular stating that a Committee of the Board has been instructed, during such time as may be found available pending the construction of the apparatus ordered by the Board for use in general work, and during such intervals as may subsequently be properly appropriated to such purpose, to investigate the mechanical, physical, and chemical properties of the alloys of the useful metals, and to determine if possible their interdependence and the laws governing the phenomena of combination and of their resistance to stress. The Committee desire to obtain records of all experiments which have hitherto been made in this direction, and to secure such exact information as may assist further researches. It is desirable that such records should embody a statement of the precise chemical constitution of each alloy examined, as obtained both by synthesis and subsequent analysis. Its specific gravity, specific heat, conductivity, its combining number, and the relation of its chemical constitution to the series of similar compounds produced by alloying the elements in the proportions of chemical equivalents, should be stated whenever possible. A few thoroughly well studied examples will be of more service than a large number of isolated determinations of single facts. It is further desired that the ultimate strength, the elastic limit, the modulus of elasticity, the ductility resilience, homogeneousness, hardness, and other mechanical properties of the specimen be ascertained and accurately stated. Where only a part of this work can be done by the investigator, this Committee is prepared to assume charge of the remaining portion of the research, when the alloy can be furnished in proper quantity and form. References to published accounts of similar works and monographs on any branch of the subject will be accepted. Special researches made for this Committee will be received with appropriate acknowledgments. The departments of physics and of chemistry in the various colleges and universities will probably be able to render valuable aid, and their cooperation is earnestly requested. The schools of engineering are in a position to assist this Committee very effectively, and their contributions will be thankfully accepted. Suitable blanks upon which to record the data offered, will be furnished upon application. Specimens of alloys for test by the Committee must be accompanied by a statement upon these blanks of their precise constitution, and such information as it is possible to give, with an account of such peculiarities as are known to distinguish the alloy, and of the special object which it is supposed may be attained by the investigation. Where possible, it is required that one or more specimens shall be furnished of each of the specified kinds, and of precisely the form and dimensions, which will be given on application.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 820.

SOME FURTHER OBSERVATIONS ON THE SPECTRA OF LIGHTNING.

By J. W. CLARK.

ABOUT 10.30 in the evening of August the 8th (Sunday) a few flashes of *sheet* lightning were seen in the south, but nothing more was observed until 1.30 a.m. Monday morning, when, from a window facing the east, bright and frequent flashes were visible. The sky was partially clouded over, and the wind occasionally very high.

In a previous number of the CHEMICAL NEWS (vol. xxx., p. 28) are recorded the results of my previous observations on the spectrum of sheet lightning: the following confirm and extend them. The observations were made with one of Browning's hand spectroscopes. At first the slit was wide, but, as the flashes became more brilliant and more frequent, it was gradually narrowed, whilst leaving the spectrum sufficiently bright. Many of the flashes exhibited only the centre of the spectrum, which was of a bluish white colour, and varied slightly in length. With the most brilliant flashes, however, the red end of the spectrum was bright, whilst the middle and blue end (when present) was of the same bluish white colour throughout.

Shortly after 2 o'clock the sky became more clouded, and the sheet lightning was gradually succeeded by brilliant *forked* lightning, which, with a narrow slit, gave a very bright *continuous* spectrum of normal appearance.

On one occasion the red end of the spectrum appeared traversed with two or three red lines, and the green with a few atmospheric absorption lines in two other cases. These three observations are, however, not very reliable.

Towards the close of the storm, which accompanied the forked lightning, 0.395 of an inch of rain and hail fell* in about twenty-five minutes; but soon after 3 o'clock the sky was clear, but occasional appearances of sheet lightning were visible until nearly 4 o'clock.

That no lines should have been observed in the spectrum of the forked lightning, and no bands in that of the sheet lightning, is somewhat remarkable, as a large number of observations were made between 1.30 and 3 o'clock, during a considerable part of which time the flashes of lightning were so frequent as to be almost continuous, and a great many were of unusual brilliancy.

ANALYSIS OF THE SULPHUR WELL, BALLYNAHINCH SPA.†

By Dr. ANDREWS, F.R.S. L. & E.

THE waters of the Ballynahinch Spa have enjoyed a local reputation for more than a century, and are still resorted to by visitors and invalids from Belfast and the surrounding district. No analysis, except an imperfect one by Sir R. Kane, has been published, so far as I know, of the Sulphur Well. The water examined by that able chemist must have been altered by keeping, as no mention is made in the analysis of any of the constituents upon which the active properties of the water depend. The following analysis refers to the Sulphur or Lower Well, and was made so long ago as 1869. The temperature of the well, about 11 o'clock on July 21 of that year was 95° C., or 49.1° F. The amount of sulphides was care-

fully determined in the pump room by observing the quantity of water required to decolourise a standard solution of iodine. Portions of the water were taken at the same time for analysis in well closed and perfectly filled bottles. If care be taken to fill the bottle fully with water at the well, without leaving a bubble of air in it, and if the bottle is afterwards kept with the neck downwards and under water, the spa water may be preserved with little change for several weeks. But the presence of even a small quantity of air will cause the decomposition of the sulphides in a few hours, and deprive the water of its useful properties.

The following are the constituents in 1000 parts of the water of the Sulphur Well:—

| | | |
|--------------------------|-------|--------|
| Bicarbonate of calcium | .. .. | 0.1049 |
| Bicarbonate of magnesium | .. .. | 0.0462 |
| Sulphate of magnesium | .. .. | 0.0175 |
| Chloride of magnesium | .. .. | 0.0037 |
| Chloride of sodium | .. .. | 0.0165 |
| Sulphide of potassium | .. .. | 0.0044 |
| Sulphide of sodium | .. .. | 0.0012 |
| Silica | .. .. | 0.0012 |
| Organic matter | .. .. | 0.1040 |

Saline constituents 0.2996

The free gaseous constituents in 1000 volumes of the water are—

| | | |
|-----------------------|-------|-------|
| Sulphuretted hydrogen | .. .. | 3.55 |
| Carbonic acid | .. .. | 70.00 |
| Nitrogen | .. .. | 19.50 |

From the foregoing analysis it appears that the saline constituents in this water are insignificant, and that its active properties are due to the sulphides and carbonic acid contained in it. Of its value as a mild sulphur spring, I have no doubt whatever, and I shall be gratified if the publication of this analysis should draw attention to it.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 54.)

THE more we must hope that the manufacture of oxygen may be saved by the metallurgical demand. In medicine it has not found any general application. According to Pereira,† in spite of certain modern eulogies of the healing power of oxygen, there is, in the opinion of competent judges,‡ little to be said on the subject. We quote the passage:—

"Soon after the discovery of oxygen gas, a strong feeling arose in favour of its medicinal applications. Various diseases, *e.g.*, scurvy, were ascribed to a deficiency of it in the system, and it was accordingly employed in many cases, and, as was at first declared, with brilliant results. In England, it was tried by Beddoes and Hill.|| The latter declares that he found it useful in asthma, weakness, ulcers, gangrene, white swellings, and scrofulous affections of the bones. These views have been again abandoned, both on chemical and physiological grounds. In asphyxia, from want of air, or from the inspiration of pernicious gases, oxygen gas may be inhaled with advan-

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Pereira, "Heil Mittel Lehre," Buchheim's German edition, vol. i. p. 217.

‡ Verbal communication from Professor Oscar Liebreich.

|| "Considerations on the Use of Factitious Air and on the Manner of Obtaining them in Large Quantities," by F. Beddoes and J. Watt; Bristol, 1794-95. It is well known that, in 1793, a Pneumatic Institute was founded at Bristol, in which the medicinal properties of gases were examined, and where Humphry Davy discovered the effects of nitrous oxide.

* Recorded by the Meteorological Department of the Ordnance Survey Office, Southampton, not far from which these observations were made.

† From the *Proceedings of the Belfast Philosophical Society*.

tage. From the same reason, it has been recommended in spasmodic asthma attended with danger of suffocation. Still it is, at the best, a mere palliative, and can by no means prevent renewed attacks. If we consider, in the application of oxygen gas, its physical action, as already discussed, we shall readily conclude that the inspiration of oxygen is in most cases useless, and that but little—and only in few cases—can be expected from its therapeutical application.

Nevertheless, an "Inhalatorium," recently opened in Berlin, sells oxygen at 6 silver groschen per cubic foot (20 marks per cubic metre), and oxygenated water at 1½ silver groschen per bottle.* As water at 0° does not absorb 4 per cent of its volume, a half-litre bottle does not contain 20 c.c., or 0.0017 grm., of the gas! To expect any effect from such a dose appears irrational.

Just as concentrated food is recommended for travellers, so oxygen has been proposed to be inhaled by those who climb the highest summits of mountains or attain altitudes in balloons where the rarefaction of the atmosphere occasions dangerous affections.† P. Bert‡ has exposed himself and others, in a suitable apparatus, to dilutions of air far surpassing that encountered at the greatest altitudes hitherto reached. The difficulty of breathing and the symptoms of suffocation which appeared when the barometer indicated 300 to 250 m.m. were relieved, according to his account, by a single inspiration of pure oxygen. Dilution of oxygen with atmospheric air was found more advantageous than the pure gas; and on a balloon voyage which Croce-Spinelli and Sivel undertook from Paris, March 22nd, 1874, they took with them mixtures of 45 and 75 per cent of oxygen (and therefore 55 and 25 of nitrogen). With the aid of this mixture they were able to conduct valuable physical observations at leisure, and without bodily inconvenience, at the height of more than 6000 metres; and although Glaisher succeeded, without this auxiliary, in attaining still greater heights, it cannot be denied that oxygen gas affords the means of exploring atmospheric regions hitherto unknown.

The physiological applications of oxygen lead us naturally to that modification which bears the name of ozone, with which, in the outset, high therapeutical hopes were connected.

(To be continued.)

ON GLYCOGEN AND GLYCOCOLL IN THE MUSCULAR TISSUE OF PECTEN IRRADIANS.¶

By RUSSELL H. CHITTENDEN,
Assistant in Physiological Chemistry, Yale College.

THE genus *Pecten* is world-wide in its distribution. The species *irradians* is entirely American, being found most abundantly on the eastern shores of the United States. It is closely allied to the European and English species *opercularis* and *maximus*. The large central muscle which closes the valves of this mollusc is highly valued as an article of food, although its peculiar sweet taste is objectionable to some. With this central muscle the following experiments were made:—

Glycogen.—By extracting the edible portion of the scollop with cold water, a milky opaque fluid with slight acid reaction is obtained, and an insoluble residue consisting principally of syntonin or fibrin mixed with inorganic matters. The strong opacity of the aqueous solution is not due to an emulsion of fatty matters. On boiling the solution with or without the addition of acetic acid, a large amount of albumen is precipitated, leaving the fluid still opalescent. On treating the fluid, after the removal of albumen, with a small amount of 95 per cent

alcohol, a light flocculent precipitate is obtained which dissolves by agitation, leaving the fluid unaltered in appearance; but, if three or four volumes of the alcohol are added, a copious permanent precipitate settles, leaving the supernatant fluid perfectly clear. This precipitate is of snowy whiteness, except when previous to precipitation the fluid has been boiled considerably, in which case both filtrate and precipitate assume a yellow or brownish colour, from which the latter can be freed by solution in cold water and re-precipitation by alcohol. The precipitate, if allowed to dry in contact with air, after having been washed with alcohol merely, soon becomes translucent on the edges, and finally is transformed completely into a gummy mass which is sticky when moistened; but, if after precipitation it is washed with ether thoroughly, it loses this property of becoming gummy, which seems to be due to the presence of water and of albuminous matters in small quantity. This gum-like mass, when hard, is brittle, and yields, on trituration, a white hygroscopic powder showing under the microscope no distinct structure. A portion of the precipitate so prepared, dried in the air, yielded by analysis:—

| | 1. | 2. | Calculated. C ₆ H ₁₀ O ₅ + H ₂ O or C ₆ H ₁₂ O ₆ . |
|---------|-------|-------|---|
| C | 39.52 | 39.56 | 40.00 |
| H | 6.62 | 6.55 | 6.60 |
| O | 53.86 | 53.89 | 53.34 |

In this state it is not quite pure, giving with Millon's reagent a strong reaction for albumen, and containing some inorganic matter—one specimen 1.57 per cent, another 1.38 per cent—consisting in all cases, so far as were examined, of calcium phosphate. From this analysis it is seen that the substance has the formula of the sugars, or that of the starch group *plus* a molecule of water. The substance is tasteless, gummy when moistened, and gives an opaque fluid with water, seemingly a true solution, which passes unchanged through filter-paper and animal charcoal, and shows no particles under the microscope with a half-inch objective. When this aqueous solution is boiled, thin films separate, forming a scum on the top of the fluid, which goes into solution again as the liquid becomes cool. The substance is insoluble in alcohol and ether, has no reducing action with cupric sulphate and sodium hydroxide, but, when boiled with a few drops of dilute hydrochloric acid, gives a clear fluid which has strong reducing action. This same reaction takes place also with nitric and sulphuric acids, but not so readily as with the former. A portion of the substance was treated with a small quantity of saliva at the ordinary temperature and at 40° C., and in both cases the ptyalin acted immediately upon it and sugar was formed. Treated with a solution of iodine in potassium iodide, a brownish red or maroon colour was obtained. These and other reactions pointed to glycogen. It was yet to be ascertained whether the sugar formed by the action of acids and ferments was glucose, also to examine the action of boiling dilute nitric acid upon it, and to determine whether the different formulæ of glycogen could be obtained by drying it at different temperatures. A portion of the substance was then boiled with hydrochloric acid until alcohol produced no precipitate in a sample tested, the excess of acid removed by oxide of silver and the sugar obtained by evaporation. The product had all the properties of glucose, was intensely sweet, reduced alkaline solutions of copper and silver, and yielded Pettenkofer's reaction. Analysed, it gave the following result:—

| | 1. | 2. | Calculated. C ₆ H ₁₂ O ₆ + H ₂ O. |
|---------|-------|-------|--|
| C | 36.15 | 36.17 | 36.36 |
| H | 6.82 | 6.88 | 7.07 |
| O | 57.03 | 56.59 | 56.57 |

By the action of boiling dilute nitric acid, oxalic acid was formed and separated. A different sample of the original substance, dried over sulphuric acid until a constant weight was obtained, yielded—

* Eight silver groschen=four-fifths of a shilling sterling.

† Fonvielle, "La Science en Ballon," Paris, 1869.

‡ Bert, *Comptes Rendus*, 1874, p. 911.

¶ Communicated by the Author.

| | 1. | 2. |
|---------|-------|-------|
| C | 43.81 | 43.90 |
| H | 6.43 | 6.46 |
| O | 49.76 | 49.64 |

A sample dried at 100° C. gave, by analysis—

| | 1. | 2. | Analysis of Starch Dried at 100° C. by Mulder. |
|---------|-------|-------|--|
| C | 43.86 | 43.89 | 43.86 |
| H | 6.41 | 6.38 | 6.28 |
| O | 49.73 | 49.73 | — |

A sample dried at 140° C.—

| | 1. | 2. | Analysis of Starch Dried at 140° C. by Mulder. |
|---------|-------|-------|--|
| C | 44.32 | 44.40 | 44.47 |
| H | 6.38 | 6.41 | 6.28 |
| O | 49.30 | 49.19 | — |

On treating an aqueous solution of the substance at the ordinary temperature with an excess of a saturated solution of barium hydroxide, a heavy white precipitate was obtained, soluble in water, insoluble in baryta water and alcohol. This precipitate was dissolved in water, the baryta removed by a little dilute sulphuric acid in the cold, and then re-precipitated by an excess of alcohol.

Prepared thus, it seemed to have lost the property of becoming gummy so readily as before, and on examination was found to be completely free from albuminous matters, giving no reaction even with Millon's reagent, and also contained only 0.61 per cent of ash. The substance, dried at 100° C., gave, by analysis, the following result, agreeing closely with that of the preceding preparation dried at the same temperature:—

| | 1. | 2. |
|---------|-------|-------|
| C | 43.93 | 43.91 |
| H | 6.45 | 6.40 |
| O | 49.62 | 49.69 |

Another sample, prepared in the same way, and dried between 110°—120° C., gave—

| | 1. | 2. |
|---------|-------|-------|
| C | 43.56 | 43.63 |
| H | 6.71 | 6.71 |
| O | 49.73 | 49.66 |

Casting a backward glance, we see that the analysis of the air-dried substance corresponds with the formula $C_6H_{12}O_6$, that of the substance dried at 140° C. with $C_6H_{10}O_5$, which requires 44.44 C, 6.11 H. These results agree with glycogen, which in different states of hydration has been found to have the formulæ $C_6H_{10}O_5$, $C_6H_{12}O_6$, and $C_6H_{14}O_7$. But the results obtained by the analyses of the substance dried at 100° C. and 110°—120° C. do not agree closely with any of the above formulæ. The same is true of members of the starch group to which glycogen is closely related, and lately Dr. Nägeli* has published a paper in which he points out that the elementary composition of starch, dextrin, and "amylo-dextrin," dried at temperatures not exceeding 116°, agrees better with the formula $C_{36}H_{62}O_{31}$, which requires 43.63 C, 6.3 H, than with $C_6H_{10}O_5$, and that after exposure to a temperature of 140° C., when the composition corresponds to $C_6H_{10}O_5$, we probably do not deal with undecomposed starch. The analysis of amylo-dextrin by Nägeli (*loc. cit.*, p. 35), dried in a stream of hydrogen, at a temperature of 112° to 116° C., gave the following result:—

| | 1. | 2. |
|---------|-------|-------|
| C | 43.58 | 43.85 |
| H | 6.86 | 6.58 |

A sample of dextrin dried at the same temperature gave Nägeli, as a mean of two analyses, C 43.52, H 6.78, in both cases agreeing closely with my analyses of glycogen dried at 110°—120° C. Thus this substance, which is without doubt glycogen, coincides in this respect with its neighbours, dextrin, amylo-dextrin, &c.

A sample of glycogen, prepared by the preceding

methods and dissolved in water, on treatment with basic lead acetate, with the application of a gentle heat, yielded a heavy gelatinous precipitate, which, when filtered off by the aid of a pump and washed with water, was found to contain lead. Dried at 100° C., it gave, by analysis, the following result:—

| | 1. | 2. |
|----------|-------|-------|
| C | 21.62 | 21.78 |
| H | 2.91 | 2.96 |
| Pb | 48.39 | 48.34 |
| O | 27.08 | 26.92 |

Since this result was obtained, I find that M. Bizio* has already discovered glycogen in some invertebrates. Among the molluscs, he found it in considerable quantity in the oyster.

With glycogen from these sources he prepared a lead compound by means of tribasic acetate of lead, and says its "analysis has given me the formula $C_{12}H_{18}PbO_{10}$," which requires—

| | |
|----------|-------|
| C | 27.22 |
| H | 3.40 |
| Pb | 39.13 |
| O | 30.24 |

It will be seen at once that my result does not agree with this formula. I therefore made some further lead precipitates from the same and other preparations of glycogen, and in these simply determined the lead as follows:—

| Pb. | 1st Prep. | 2nd Prep. | 3rd Prep. | 4th Prep. |
|----------|-----------|-----------|-----------|-----------|
| No. 1 .. | 48.39 | 53.63 | 51.45 | 50.27 |
| No. 2 .. | 48.34 | 53.58 | 51.45 | 50.28 |

Some glycogen was also prepared from the liver of an ox by the usual method and dried at 100°. It yielded, by analysis:—

| | 1. | 2. | Calculated. $C_{12}H_{24}O_{11}$. |
|---------|-------|-------|---------------------------------------|
| C | 41.87 | 41.90 | 42.11 |
| H | 6.35 | 6.38 | 6.43 |
| O | 51.78 | 51.72 | 51.46 |

A lead preparation made from this gave—

| | 1. | 2. |
|----------|-------|-------|
| Pb | 61.99 | 61.94 |

These results indicate that the composition of the precipitate is not constant.

The amount of glycogen occurring in this muscular portion of the scollop is quite large; at one time, from 3 quarts 160 grms. were obtained; at another, 2 quarts yielded 70 grms.

Glycocolloids.—On evaporating the alcoholic filtrate from the precipitated glycogen until quite concentrated, and adding neutral lead acetate, a heavy white precipitate is produced, which is a combination of inorganic matters with the lead. The excess of lead is then removed from the filtrate by hydrogen sulphide, and after concentration the liquid is decolourised by animal charcoal. On further evaporation, the fluid deposits white prismatic crystals. The crystals have a sweet taste, but, upon ignition with soda-lime, ammonia is evolved, evincing the presence of nitrogen, which at once separates it from the saccharine group. The crystals first obtained were not quite pure, but after treatment with animal charcoal and re-crystallisation gave, by analysis, a result corresponding to the composition of glycocolloids. Two more distinct preparations were made, and gave, by analysis:—

| | | 1st Prep. | | 2nd | 3rd | Calculated. |
|---|----|-----------|-------|-------|-------|-----------------|
| | | | | Prep. | Prep. | $C_2H_3O_2NH_2$ |
| | | 1. | 2. | | | |
| C | .. | 31.98 | 31.99 | 32.09 | 31.97 | 32.00 |
| H | .. | 6.88 | 6.84 | 6.79 | 6.81 | 6.66 |
| N | .. | 18.57 | 18.58 | 18.49 | 18.45 | 18.66 |
| O | .. | 42.57 | 42.59 | 42.63 | 42.67 | 42.66 |

The impurities which seemed to be the most difficult to remove were colouring and inorganic matters. The

* "Beiträge zur näh-
ter Nägeli. 187

tniss der Stärke Gruppe." Dr.

* Comptes Rendus, lxx., 175. Zeitschrift für Chemie, 1867, 745.

crystals were soluble in water and weak alcohol, insoluble in ether and absolute alcohol. An aqueous solution, when treated with sulphate of copper and sodium hydroxide, assumed an azure blue colour without separation of cuprous oxide on heating. The substance melted at about 180°C ., then decomposed. With nitric acid, fine crystals corresponding to nitrate of glycocoll were obtained. These analyses and reactions identify the substance as glycocoll, which I believe has never before been found in nature.*

A preparation was now made in which the alcoholic filtrate from the precipitated glycogen was evaporated without the addition of any reagents, and here the same crystals were obtained mixed with a considerable quantity of inorganic matters and some dextrose.

The amount of glycocoll occurring in the tissue is small, although where two or three quarts of material are used a fine crop of crystals may be obtained.

The quantitative analysis of the edible or muscular portion of the scollop, as obtained at the market, is as follows:—

First Analysis.

| | 1. | 2. |
|--|-------|-------|
| Water | 79.60 | 79.66 |
| Solids | 20.40 | 20.34 |
| Ash | 1.26 | 1.26 |
| Nitrogenous matters (= $\text{N} \times 6.4$) | 15.68 | 15.68 |
| Ether extract | 0.33 | 0.28 |
| Non-nitrogenous, by difference | 3.13 | 3.12 |

Second Analysis.

| | 1. | 2. |
|---------------------------------|-------|-------|
| Water | 80.25 | 80.25 |
| Solids | 19.75 | 19.75 |
| Ash | 1.24 | 1.22 |
| Nitrogenous matters | 15.04 | 15.04 |
| Fatty matters | 0.32 | 0.24 |
| Non-nitrogenous matters | 3.15 | 3.25 |

Total amount of nitrogen in the substance dried at 100°C .:—

| | 1. | 2. |
|-----------|-------|-------|
| N | 11.35 | 11.37 |

The percentage of glycogen was determined in two separate quantities.

| | 1. | | 2. | |
|------------------|------|------|------|------|
| | 1. | 2. | 1. | 2. |
| Glycogen | 2.43 | 2.40 | 1.98 | 2.19 |

The percentage of glycocoll was determined, but, owing to the inaccuracy of the method, can be considered only as an approximation to the truth.

| | 1. | 2. | 3. | 4. |
|-------------------|------|------|------|------|
| Glycocoll | 0.46 | 0.68 | 0.71 | 0.39 |

The ash of the muscle consisted of the bases, soda, potash, magnesia, and lime; acids, chlorine, sulphuric and phosphoric.

In conclusion, I wish to express my obligations to Professor S. W. Johnson for advice freely given.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.†

By H. CARRINGTON BOLTON.

(Concluded from page 57).

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Invaluable as a work of reference. Abounds in information concerning chemists of every age and nation.

* "Lehrbuch der Physiologischen Chemie, Gorup-Besanez," p. 236. 1875.

† From the *Annals of the Lyceum of Natural History, N. Y.*, vol. x.

HOEFER, FERDINAND. *La Chimie enseignée par la biographie de ses fondateurs, R. Boyle, Lavoisier, Priestley, Scheele, Davy, &c.* 12mo. Paris, 1865.

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A rather hasty though compendious history, including notices of living chemists and modern researches.

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Valuable; well known for its much criticised opening sentence: "La Chimie est une Science Française."

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KOPP, HERMANN. *Die Entwicklung der Chemie in der neueren Zeit.* 8vo. München, 1871—73.

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A continuation of Zuchold's "Bibliotheca Chemica," similarly arranged but evidently collated with less care and completeness.

RODWELL, G. F. *The Birth of Chemistry*; in "Nature," Vols. VI. and VII., 1872—73.

A popular essay full of research, especially rich in the knowledge of the Egyptians. It embraces only the period prior to 1680.

Certain Property of Ferric Ortho-Phosphate.—

Fausto Sestini.—The yellowish white precipitate thrown down from the solution of a ferric salt on the addition of any solution containing an ordinary phosphate, $\text{Fe}_2(\text{PO}_4)_2$, is generally stated to be insoluble in water and in acetic acid. The author finds, however, that it is not absolutely insoluble in acetic acid; that its solubility in acetic acid is not augmented by the presence of chloride of ammonium; and that cold water withdraws a portion of the phosphoric acid. By the action of boiling water the salt is decomposed, the phosphoric acid being, to a great extent, dissolved, and the iron remaining as an insoluble basic phosphate.—*Gazzetta Chimica Italiana.*

SOCIETY OF PUBLIC ANALYSTS.

IMPROVEMENTS IN BUTTER ANALYSIS.*

By ARTHUR ANGELL, F.R.M.S.

THE saponification of fats and the estimation of fixed fatty acids, after the subsequent decomposition of the soap, as applied to the estimation of foreign fats in the butters of commerce, was the original conception of my friend and colleague, Mr. Otto Hehner, assistant to Dr. Hassall; the matter was, however, worked at for months by myself in conjunction with him, before we ventured to make public the results of our researches. My friend Mr. George Turner, of Portsmouth, has improved the method, and rendered it more valuable by shortening the time needed, without jeopardising the accuracy of the results obtained.

The whole process, in the case where the percentage of every constituent of a fatty compound is required, may be conveniently considered under the three following heads, for each of which a separate part of the sample is required.

- I. Microscopic examination.
- II. Determination of water, fat, casein, and salt.
- III. Determination of the point of fusion, and estimation of fixed fatty acids.

I propose to say nothing about the methods for the estimation of water, salts, &c., they being well understood by all, and the taking of the point of fusion has already been treated with here on another occasion; there is therefore only the microscopic examination and the estimation of fixed fatty acids to be dealt with.

In butter analysis it is dangerous to rely implicitly upon microscopic appearances; the microscope, however, should not be entirely dispensed with, it frequently affords valuable corroborative evidence.

In no case does any fat in the raw state show traces of crystals; on the contrary, when a fat is fused the membrane is broken up, and all the constituents are melted into an oily liquid, from which, on cooling slowly, the stearin and palmitin partly crystallise out. Beef, mutton, and pork fat in the raw state show large cells of adipose tissue, the contents of which depolarise light in an irregular manner.

Pure butter has no effect upon polarised light except when it has been heated and allowed to cool again; when cooled very rapidly no perfect crystals are formed, but the mass has a slight depolarising power which it did not possess when in the virgin or raw state.

If, therefore, upon pressing a small portion of the sample into a thin layer, and viewing it by polarised light, it shows stellate masses of crystals, it is a proof that some part of the fat has been melted down; and if no definite crystalline forms can be made out, but some portions or the whole of the mass possess any power over the polarised ray, it is probable that an animal fat in the raw state has been crushed and added in the cold. It must not be forgotten that it is quite possible that in the summer time the outside portion of a pure butter may have become fused and crystalline.

Thus far, and no farther, as it seems to me, can the microscope assist us in this matter, but even such indications are valuable, especially when subsequent analysis proves the sample to be an adulterated article, the microscopic evidence in such a case frequently helps to clench together the whole superstructure, and thus certainty is made doubly sure.

All fats being built up of the glycerides of the insoluble acids, stearic, oleic, and palmitic,—with in some cases the soluble, butyric, caproic, caprylic, and capric acids,—are capable of being saponified; that is to say, when treated with caustic alkalies glycerin is set free, and the base forms soluble salts with the acids, together producing a clear soap: upon the addition of a strong acid a new

potash salt is formed, and the fatty acids are set free; those which are insoluble rise to the top in a foamy mass, which upon continued heating forms a clear stratum of fat, and are thus separated from the soluble acids and glycerin (which remain in solution).

By distillation we obtained 6 or 7 per cent of these soluble volatile constituents of butter, but could not get reliably constant results: that method was therefore abandoned, and their percentage determined by difference. The oily, fixed, fatty acids being caught upon a filter, washed, dried, and weighed, were found to give constant results.

The quantity of fatty acids obtained from twelve different samples of butter—quoted in "Butter, its Analysis and Adulterations"—varies from 85.40 to 86.20, showing a difference of 0.8 per cent. The average of our twelve samples of butter is 85.85 per cent of fixed acids.

The difference between the quantity of fatty acids found in butter and that found in other fats is therefore, on an average, 9.65 per cent.

Mixtures will yield quantities lying between 85.85 and 95.5 per cent. An adulteration of 100 per cent—that is, the substitution of any foreign fat for butter—would give a difference of 9.65 per cent: an adulteration of 10 per cent, therefore, would give a difference of 0.965 per cent. Each tenth of a percentage of fatty acids above the average figure would consequently be equal to 1.036 per cent of adulteration: it would, however, be unjustifiable to declare a sample of butter to be adulterated because the fatty acids lie three- or four-tenths of a percentage above the average figure. A difference of $\frac{1}{2}$ per cent and above would, of course, constitute an adulteration.

To gain an idea of the accuracy to be obtained by our method, one of us prepared mixtures of foreign fat with butter, which the other analysed, without having an idea of the composition. The following results were obtained:—

| Whole Butter. | Lard. | Foreign Fat, calculated from percentage of Fatty Acids obtained. |
|---------------|----------------|--|
| Per cent. | Per cent. | |
| I. .. 82.70 | 17.30 | 14.70 |
| II. .. 81.10 | 18.88 | 18.55 dif. 0.33 |
| III. .. 69.79 | 31.21 beef fat | 31.42 |

The sinking-point of this last mixture was 39.5° C., 4° above that of genuine butter: these 4° are due to 35.02 per cent of foreign fat: 100 per cent of it would, therefore, raise the sinking-point 11.4°, making it 46.9°. Fat having a high fusing-point (in this case ox-fat) has therefore been used as an adulterant.

The process of saponification as first carried out by us is as follows:—From 3 to 4 grms. of perfectly dry butter-fat are weighed out from a test-tube into a large, deep, porcelain dish; about three-fourths of a stick of caustic potash in solution is added; the mixture is kept boiling, with frequent stirring and addition of evaporated water, until a perfectly clear soap is obtained: this usually takes from 3 to 6 hours. The soap, whilst warm, is decomposed with weak hydrochloric acid, and the heat kept up until the released fatty acids form a clear oily stratum on the hot solution of potash salts, glycerin, and soluble acids.

The fixed acids are caught upon a wet filter (which it is as well, but not absolutely necessary to keep warm with a steam or hot water jacket), and well washed with boiling water until the filtrate is quite free from acid reaction, or any odour of volatile acids. It is necessary to use a large amount, half a litre of wash water, in order to get rid of every trace of the acids, some of which, especially caprylic acid, are very sparingly soluble in water; when well washed the fixed acids soon become constant in weight.

Mr. George Turner, of Portsmouth, has recently discovered that by making use of alcohol in the process of saponification, much time may be saved, and that without in the least degree interfering with the accuracy of the method; in which the fat seems to be

* Read at the meeting of the Society on June 2.

presented to the action of the alkali in a finely divided condition, and therefore chemical changes are speedily brought about. A clear and perfect soap may be got in from fifteen to thirty minutes.

The process is as follows:—3 to 4 grms. of fat are weighed into a porcelain dish, capacity about 100 or 150 c.c., melted over water-bath and treated with from 20 to 30 c.c. alcohol, or methylated spirits; three-quarters of a stick of potash is added, and then water a few drops at a time, so as to gradually dissolve the potash; by adding the water carefully at intervals until this point is reached, no turbidity, or only a transient one, is produced, and afterwards it may be used freely. The soap must now be quite freed from alcohol by boiling; when this point is reached it remains perfectly clear, has no spirituous smell, and usually a soapy pellicle forms on the surface.

The advantages of saponifying with the aid of alcohol over our original method, with water and KHO only, are that violent boiling is dispensed with, and that the dish is smaller, and exposed for a shorter period to the solvent action of the alkali, besides which much time is saved.

It is a matter of the utmost importance that the fat should be perfectly dry, and free from every trace of casein and salt. I have found that after prolonged heating in the water-bath, filtration is a tolerably quick and sure method of obtaining this condition.

Great care must be observed in the washing, never to allow any part of the filter to become dry, or fat will surely pass through.

NOTICES OF BOOKS.

A Digest of the Reported Cases Relating to the Law and Practice of Letters Patent for Inventions. By CLEMENT HIGGINS, M.A. F.C.S., of the Inner Temple, Barrister-at-Law. London: Butterworths.

THAT modest and virtuous party who agitate for the abolition of patent-right argue that their scheme, even if fully successful, would not check the career of industrial improvement. "The inventor," say they, "is like a hen which cannot help laying." Whilst duly appreciating the bare-faced cynicism of this comparison, we will, for argument sake, take them at their word.

A hen may not be able to help laying, but if not made comfortable at home she may "lay away." Just so the inventor; if he finds himself systematically pillaged in his native country may carry his ideas to where they will be better appreciated. Already industrial and scientific papers in America are speculating on the consequences of the Lord Chancellor's meditated inroads on the old patent laws of England. They are very plainly reminding the British inventor that if deprived of his indisputable rights at home he will be received with open arms in the United States, where for the small sum of 35 dollars he can secure an invention, not for seven or fourteen, but for seventeen years, without being called upon for any further payment, where though a thousand patents are granted monthly, the average value of a patent is greater than in Europe, and where from the more enterprising character of manufacturers and capitalists an improvement can more readily meet with a fair trial. Hence we believe that the Lord Chancellor's bill, outrageous as are certain of its provisions, will, if carried, prove far more injurious to British manufacturing supremacy than to the general progress of industrial science, or than to inventors as individuals.

It is perfectly natural that at such a juncture, when our old patent system, without which, as an eminent German contemporary observes, the colossal industry of Britain would be "simply inconceivable" an increased attention should be paid to the laws bearing upon the subject of protection to inventions, and to the decisions by which the Courts are in a great measure guided. The appear-

ance of Mr. Higgins's "Digest" is therefore exceedingly opportune. The plan of the work is definite and simple. The author, as he remarks in his preface, has sought to furnish "a reliable and exhaustive summary of the reported patent law cases decided in English Courts of Law and Equity. No opinion is expressed upon the cases given, and no attempt is made to reconcile conflicting decisions. All that the book contains rests upon the authority of the judges." The decisions are arranged under such heads as subject-matter of letters patent, novelty of invention, utility of invention, who may be a patentee, application for letters patent, grant, title of patent, provisional and complete specification, &c. The cases under each of these sections are classified in order of time.

Among the most interesting points handled in the work is the question as to whether a principle can be made the subject of a patent. On this head the decisions quoted are unanimously negative. You may patent any novel method of carrying a given principle into beneficial effect, but the principle itself remains public property. Thus, taking the well-known instance of a red colouring matter derived from the action of oxidising agents upon mixtures of aniline and toluidin. So soon as one oxidising agent had been claimed for effecting this purpose there was a perfect rush of applications, until every known oxidising agent, suitable or unsuitable, had been patented for the purpose in question. Now the bulk of these patents were neither useful nor meritorious. If it is once known that a certain effect can be produced by an oxidiser, there is very little merit in turning over the leaves of some manual of chemistry, selecting some other oxidising agent there mentioned, and patenting it for the object in question. Therefore it has been contended, we should allow a right in principles and enable the first discoverer of magenta to claim the action of oxidising agents upon mixtures of aniline and toluidin. To this the reply is obvious. Some oxidising agent might be hereafter discovered, better adapted for the manufacture of magenta than any then known. Would it then be fair to give the original patentee an exclusive right to something not in existence at the time of his patent and only elicited since by the labour and sagacity of some other person?

We may on future occasions return to this subject, and to other of the many interesting questions which the decisions before us naturally suggest. We consider that Mr. Higgins, in the production of this work has met a long-felt demand. Not merely the legal profession and patent-agents, but patentees, actual or intending, inventors, manufacturers and their scientific advisers will find the "Digest" an invaluable book of reference.

CORRESPONDENCE.

ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-MAGNESIAN PHOSPHATE.

To the Editor of the Chemical News.

SIR,—Mr. Warrington was kind enough a few days ago to write to me regarding my paper on the above subject (vol. xxxi., p. 274) in the following terms:—"You do not seem to mention one condition of the experiment—the excess of ammonia present. Was this condition uniform throughout? Of course the greater the excess of ammonia the more probability there is of impurities accompanying the precipitate. If you used citric acid in a free state, how did you preserve the uniform excess of ammonia?"

My reply was as follows:—"I beg to thank you for your courtesy in writing to me personally regarding the detail of my paper referred to by you. The quantity of free ammonia was the same throughout all the experiments, and I endeavoured to arrive at this result by first of all cautiously saturating the citric acid, and then adding a

definite quantity of weak ammonia, viz., 5 c.c. Owing to accidental circumstances my paper was drawn up in its present form at a time when I could not continue the experiments further and ascertain the influence of *varying quantities* of free ammonia, and also examine into other points. However, I am not prepared to admit that the amount of ammonia used by me can be held as accounting for any of the results given. I have wrought with the magnesia method for a number of years—formerly almost daily—and have not only avoided a *large excess* of ammonia, but also have taken care to add this excess in the form of a *dilute* solution.”

As no mention was made in my paper of the quantity of free ammonia used in the various experiments detailed in it, I ask you to do me the favour of inserting this note.—I am, &c.,

THOMAS ROBERTSON OGILVIE.

Greenock, August 3, 1875.

DETECTION OF COBALT AND NICKEL.

To the Editor of the Chemical News.

SIR,—I read with some surprise in (CHEMICAL NEWS, vol. xxxii., p. 44) a paper from Mr. R. H. Davies on “The Detection of Cobalt and Nickel by means of Ferro- and Ferri-cyanide of Potassium,” to which method he appears to lay claim. Allow me, as one of the students at the Pharmaceutical Society last session, to state that this method for the detection of cobalt and nickel was found out by Messrs. Compton and Gostling, two students at Bloomsbury Square last session.

A. P. LUFF.

Prospect House,
South Kensington, S.W.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Allow me a few observations on this new idea.

Mineralogy is a distinctive branch of Natural Science. It is a Science of Great National importance.

The Nation possesses a matchless Collection of Minerals.

It has also, within it, some excellent Mineralogists.

It never had a distinctive Society of Mineralogists.

Chemists and Geologists *condescend* only to Mineralogy.

(The Society of Chemists having “many other fish to fry; The Society of Geologists being absorbed in Palæontology).

The Nation has no Standard Book of Mineralogy.

The Books in general use are widely discrepant,

And treat of many Minerals of doubtful existence.

There is no uniformity of Mineral Nomenclature.

This state of things is altogether inappropriate,

Is very perplexing to our Mineralogical Students,

An avoidable hindrance to the Advance of Science,

Which a *Mineralogical Society* of London might reform.

T. A. READWIN.

Liverpool, August 7, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 2, July 12, 1875.

Magneto-Chemical Phenomena Produced in a Medium of Rarefied Gases in Geissler's Tubes Illuminated by means of Induction Currents.—M. J. Chautard.—(Third part.) In all the simple bodies of

the chlorine group, and in all their derivative compounds, gaseous or volatile, which have been examined, the action of the magnet is instantaneous, and is shown—not merely by a change in the tint of the tube—but, above all, by a more complete illumination of the rays which display a wonderful brilliancy, and are sometimes split up. The wave-lengths of each ray will form the subject of a future communication. The substances examined, beside chlorine, bromine, and iodine, are the chloride, bromide, and fluoride of silicium, the fluoride of boron, hydrochloric acid, antimony chloride, bismuth chloride, mercurous chloride, and stannous and stannic chlorides. The lights of sulphur and of selenium are completely extinguished in the moment when the magnet is set in action, and it is the same with that of tubes of chlorine, bromine, and iodine if the strength of the coil is suitable. The lustre of the light of oxygen, always pale, undergoes no very sensible change. It is the same with the compounds of carbon, such as carbonic acid and oxide, proto- and bi-carbide of hydrogen. The fine bands of the nitrogen spectrum are merely modified in the red and orange portion. These colours are almost entirely extinguished, or, at least, are replaced by a very uniform tint, in which there is no trace of “chanelling.” The bands of the more refrangible portion remain unaltered. The rays of hydrogen preserve the same appearance; yet, on employing an electromagnet of sufficient strength, we see appear at the moment when it is set in action a very brilliant yellow ray, which is merely that of sodium derived from the glass. This ray vanishes as soon as the circuit is broken, and reappears if the magnetisation is resumed. Protochloride of tin, dry and crystalline, but bihydrated, presents a most remarkable phenomenon of dissociation under the influence of the magnet. In its normal state the spectrum is pale, and presents some of the green rays of chlorine; but as the magnet is set in action we see two of the characteristic rays of hydrogen, the red and the blue, which remain as long as the magnetisation lasts, and disappears when it ceases.

Fused Boracic Acid, and on its Temper.—V. de Luynes.—Fused boracic acid, which approaches glass in some of its external characteristics, presents some properties worthy of note. In the viscid state it may be drawn out into threads, which solidify rapidly, and from this point of view its ductility rather resembles that of silica than of glass. Its hardness, between 4 and 5, places it between fluor-spar and apatite; it scratches glass, and is with difficulty attacked by sand, and even by emery, dry or with oil. It takes seven to eight times as much time in grinding as glass under the same circumstances. This resistance to friction, which does not accord with its hardness, depends doubtless, as M. Damour has recognised in the case of other minerals, on a speciality of structure. Melted boracic acid, in mass, becomes slowly hydrated in contact with water. In powder it is acted on rapidly, as shown by Ebelmen. If the powder is sprinkled with water, its temperature may rise to 100°. Boracic acid is chiefly remarkable for the persistence of its temper. If poured upon a cold metallic surface glassy plates are obtained, the under surface of which, chilled by the metal, is more strongly tempered and more expanded than the upper. Hence results a flexion which may be strong enough to cause the rupture of the plate and its projection in fragments. If poured into oil it may be obtained in small masses with short tails, under the same conditions as Prince Rupert's drops. A tempered plate of boracic acid, with parallel surfaces, acts upon polarised light like tempered glass; but whilst the latter loses this property by re-heating, boracic acid preserves it with great tenacity.

Laws of Exchange of Ammonia between the Seas, the Atmosphere, and the Continents.—M. Th. Schloësing.—The author considers that he has discovered, if not the mathematical expression of the laws sought for, yet at any rate numerical data. These he intends shortly to communicate.

Description and Analysis of a Mass of Meteoric Iron Fallen in Dickson County, Tennessee.—Lawrence Smith.—The composition of this meteorite is—

| | | | | | |
|--------|----|----|----|----|-------|
| Iron | .. | .. | .. | .. | 91.15 |
| Nickel | .. | .. | .. | .. | 8.01 |
| Cobalt | .. | .. | .. | .. | 0.72 |
| Copper | .. | .. | .. | .. | 0.06 |
| | | | | | 99.94 |

There is no trace of sulphur, and unusually slight indications of phosphorus.

Temporary Magnetisation of Steel.—M. Bouty.—A mathematical paper, not adapted for abstraction.

Determination of Sulphide of Carbon in the Alkaline Sulpho-Carbonates of Commerce.—MM. Delachanal and Mermet.—This paper requires the accompanying diagram.

Preparation of Tungsten, and the Composition of Wolfram.—M. F. Jean.—The author heats to low redness for half an hour in a crucible or in a reverberatory furnace wolfram reduced to an impalpable powder, and intimately mixed with 3 per cent carbonate of lime, and 20 to 30 per cent chloride of sodium. When the mixture is cold it is powdered, and boiled for a quarter of an hour with hydrochloric acid, which dissolves lime, ferric and manganic oxides, and leaves undissolved all the tungstic acid in the state of a crystalline powder of a fine lemon-yellow colour, which is purified by repeated washings in acid, and is then converted into tungsten by reduction with hydrogen at a red heat. The author concludes that wolfram is a tungstate of the protoxides of iron and manganese.

Certain New Derivatives of Anethol.—M. Fr. Landolph.—The author examines the hydride of anethol, or anisic camphor, $C_{10}H_{16}O$.

Researches on Emetine.—M. A. Glénard.—The author finds emetine to contain—

| | | | | | |
|----------|----|----|----|----|-------|
| Carbon | .. | .. | .. | .. | 72.25 |
| Hydrogen | .. | .. | .. | .. | 8.61 |
| Nitrogen | .. | .. | .. | .. | 5.36 |
| Oxygen | .. | .. | .. | .. | 13.78 |

represented by the formula $C_{30}H_{22}NO_4$.

Central-Blatt für Agrikultur Chemie,
Heft 5, May, 1875.

Influence of Atmospheric Pressure and Rainfall upon the Subsoil Water.—Dr. A. F. Nowack.—The water level does not rise after rainfall, but before it, and announces rain thus with more certainty than the barometer.

Beet-Root Treacle as a Manure.—A. Gawalowski.—300,000 cwt. of beet-root yielded 7500 cwt. treacle, containing 495 cwt. potash, 37.5 cwt. lime, 4.5 cwt. phosphoric acid, 15 cwt. sulphuric acid.

Wool-Waste as a Manure.—Dr. A. Petermann.—Various samples contained from 2.14 to 6.67 per cent of nitrogen.

Experiments on the Yield of Plots of Land Treated with Artificial Manures as Compared with Unmanured Plots.—Bruhn.—The manures used were superphosphate made from "Baker guano," containing 20 per cent of phosphoric acid, and blood manure containing 5 per cent nitrogen, and 6 per cent of phosphoric acid. The plots of land were very small, and the superphosphate furnished no manurial element except phosphoric acid.

A Manurial Experiment on Sugar Beets.—E. Breyermann.—The author concludes that with care good beets can be obtained even from strongly manured land.

Composition of Bones during Variations in Food.—Dr. H. Weiske.—Animals were fed on substances deficient in phosphate of lime. The total amount of

osseous matter formed in their bodies was reduced, but the chemical composition of the bones remained unchanged. The amount of magnesia in the bones was not augmented in animals to whom magnesium phosphate was purposely given. Strontia given in food only appeared in traces.

On Chitin.—O. Bütschli.—The nitrogen, by the method of Dumas, was determined at 7.4 per cent. By the process of Varrentrapp and Will it appeared 1 per cent lower. The author considers chitin as a derivative of a hydrate of carbon—probably of a body resembling cellulose.

Digestion of Albumen.—B. Maly.—The author concludes that pepton is an organisable product of digestion, capable of decomposing albumen, and of re-conversion into albumen.

Removal of Alkalies from the Animal System.—J. Kurtz.—A dog was first dosed for some time with sulphuric acid to minimise the disposable alkali in its system, and then fed with meat freed from alkaline salts, to which 2 per cent of neutral phosphate of potash was added. The excretion of soda decreased continuously.

Milk of Different Breeds of Cows on Different Diets.—A translation of a recent paper by Stevenson Macadam.

Structure of Seed Capsules.—Dr. Anton Sempolowski
Occurrence and Origin of Woody Fibre in the Tissues of Plants.—A. Bürgerstein.—A physiological paper.

On Chlorophyll.—J. Chautard, E. Prillieux, E. Filhol, and A. Batalin.—Extracts from *Comptes Rendus*.

Gas of Apples.—C. Bender.—From the *Berichte der Deutschen Chemischen Gesellschaft*, No. ii., p. 112.

Certain Chemical Changes During the Germination of the Pea.—O. Kellner.—Not adapted for abstraction.

Influence of Locality on the Composition of the Ash of the Larch.—Rudolf Weber.—The organic matter increases in a regular proportion with the height of the locality. The ashes follow the inverse proportion. The larch demands double the amount of potash and phosphoric acid which suffices for the Scotch fir, and the beech three times as much as the larch.

Composition of Must at Different Periods of the Ripeness of the Grapes.—A. Cossa, Dr. Pecile, and Dr. Porro.—The amount of sugar and extractive matter increases continuously to September 20th, after which these constituents decline.

Contributions to the Chemical Knowledge of Vegetables and Pot-Herbs.—W. H. Dahlen.—Comparative analyses of a number of vegetables in domestic use.

Distribution of Sugar and Mineral Matters in the Sugar-Beet.—Ch. Violette.—From *Comptes Rendus*, lxxix., p. 899.

Nutrition of the Sugar-Beet by Loosening the Soils.—P. Bretschneider.

Experiments on the Yield of Potatoes.

Experiments on the Yield of Hemp.—Brugger.—The crop was augmented by manuring with common salt and by loosening the subsoil.

Acid Boiling on Margueritte's Principle.—Kolb Bernard.—Experiments on "acid boiling" of the syrup drained off from the first yield in the sugar manufacture.

Composition of Washed Wool.—Prof. Max Märcker.—There exist in Germany establishments where wool growers send their wools to be washed. There is considerable doubt as to whether the wool is returned correct in quantity and uninjured in quality.

Blasting Roots with Dynamite.

Part Played by Bacteria in Putrefaction, especially in Case of Urine.—Dr. A. Hiller.

Alcoholic Formation of Milk-Sugar and Milk.—Prof. E. Reichardt.

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. v.

Products of the Action of Urea upon Asparagin and Aspartic Acid.—Icilio Guareschi.—The author's researches are incomplete, and have not led to any definite result. Among the products some appear different from those obtained by Grimaux (*Comptes Rendus*, lxxx., p. 828). He proposes to resume the subject.

Preliminary Note on Parabanic and Oxaluric Acids. Icilio Guareschi.—The author, having caused oxamide to react upon urea in order to effect the synthesis of parabanic acid, seems to have obtained oxaluric acid, probably derived from the hydration of the parabanic acid formed at first.

Vegetation of Oxalis acetosella, Rumex acetosa, and R. acetosella in a Soil Devoid of Potash.—M. Mercadante.—The plants were grown in a soil composed of 1 kilo. of sulphur mixed with the following salts:—

| | | |
|--------------------------|-------|-------|
| Nitrate of lime.. .. | 2.000 | grms. |
| Nitrate of soda.. .. | 0.792 | " |
| Phosphate of lime | 2.610 | " |
| Phosphate of soda | 0.100 | " |
| Phosphate of magnesia .. | 3.800 | " |
| Oxide of iron | 0.100 | " |
| Sulphate of iron | 0.200 | " |
| Silicate of soda.. .. | 1.000 | " |

As a substitute for organic matter were added 20 grms. of glucose. The experiments proved that potash is not indispensable for the formation of oxalic acid, it being in part replaced by lime: but the vegetation in this case is meagre, and the plant does not form seeds.

Abstract of Certain Memoirs on the Detection of Poisonous Alkaloids, Read before the Academy of Sciences at Berlin.—Prof. F. Selmi.—Incapable of useful abridgment.

M. Reimann's Farber Zeitung,
No 25, 1875.

This issue contains a notice of the "hydrosulphite" vat which has been found to effect a great economy in indigo, but the use of which, in Belgium and France, is said to be checked by the high royalty demanded by the patentees. The editor is highly indignant with these gentlemen, because they are unwilling to give dyers in Germany, where the process is not protected, instructions in its use!

The ukase forbidding the importation of artificial alizarin into the Russian Empire is supposed to have for its motive the protection of the madder cultivation in the province of Daghestan.

There are, further, receipts for a fast black on wool, a green, magenta, and pansy on mixed silks.

Turkey Reds with Artificial Alizarin.—Dr. P. Römer. Cotton yarn to be dyed with artificial alizarin is oiled in the ordinary manner used in case of madder or garancin. Perhaps one oil-bath may be dispensed with. The remainder of the process is carried on in a different manner. The treatment with tannin is suppressed, and the oiled yarns are passed at once into the alum mordant, which should be as neutral as possible. To 50 kilos. of crystalline alum take 15 kilos. of soda crystals; mix the aqueous solution, stirring well, and set the clear liquid at 5° B. The cotton steeps for a day in this liquid, and is then very carefully washed and wrung out. The dye-beck consists of alizarin and tannin, $\frac{1}{4}$ kilo. of the latter per 50 kilos. of yarn. If the water is not calcareous, 100 grms. of chalk must be added for the above quantity of cotton. The dyeing is carried on very slowly and gradually, beginning with a perfectly cold beck, which is raised to a boil in two hours, and kept at that point for another hour. The yarn is then not cleared, but raised at once with curd

soap and annatto. Treatment with tin crystals is only required for rose shades.

No. 26, 1875.

In this issue a garment dyer, expected to renovate worn-out rags, gives poetical expression to his wrongs.

There are receipts for printing a fire-red on woollen yarns and pieces; for an amaranth on the same material; a safflower-rose on cotton, a wood-blue, and an olive on woollen yarns; and a chamois on tanner's wool.

Apparatine, a new material for finishing cottons, is prepared from a mixture of 76 parts water, 16 parts potato-starch, and 8 parts soda-lye at 8° B. The starch is put into the water with constant stirring, and the lye is added. The jelly, which is quickly formed, is beaten. The finished product is a colourless, inodorous mass, of glue-like nature, and dries on exposure to the air. It is said to serve as a thickener in printing.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 12, July 22, 1875.

This issue contains no original chemical matter which has not been already noticed.

MISCELLANEOUS.

British Association for the Advancement of Science.—The arrangements for the forty-fifth meeting of the British Association, to be held at Bristol on the 25th inst., are approaching completion. The President and Lady Hawkshaw will be the guests of the Mayor, who will inhabit the new Mansion House recently presented to the city by Alderman Proctor. The Secretaries of the various Sections will be lodged at the Queen's Hotel. The following are the officers:—*President-Elect*—Sir John Hawkshaw, F.R.S. *Vice-Presidents-Elect*—The Rt. Hon. the Earl of Ducie, F.R.S.; the Rt. Hon. Sir Stafford Northcote, Bart., F.R.S.; the Mayor of Bristol; Major-General Sir Henry C. Rawlinson, F.R.S.; Dr. W. B. Carpenter, F.R.S.; W. Sanders, F.R.S. *General Secretaries*—Capt. Douglas Galton, F.R.S.; Dr. Michael Foster, F.R.S. *Assistant General Secretary*—George Griffith, F.C.S. *General Treasurer*—Prof. A. W. Williamson, F.R.S. *Local Secretaries*—W. Lant Carpenter, F.C.S.; John H. Clarke. *Local Treasurer*—Proctor Baker. The following are the Presidents and Secretaries of the Sections:—**A. Mathematical and Physical Science.** *President*—Prof. Balfour Stewart, F.R.S. *Secretaries*—J. W. Glaisher, C. T. Hudson, J. Perry, G. F. Rodwell. **B. Chemical Science.** *President*—Prof. A. G. Vernon Harcourt, F.R.S. *Secretaries*—Dr. H. E. Armstrong, W. Chandler Roberts, W. A. Tilden. **C. Geology.** *President*—Dr. T. Wright, F.R.S.E., F.G.S. *Secretaries*—L. C. Miall, E. B. Tawney, G. Topley. **D. Biology.** *President*—P. L. Sclater, F.R.S. *Secretaries*—E. R. Alston, Prof. W. R. M'Nab, F. W. Rudler, Dr. P. H. Pye Smith, Dr. W. Spencer. **E. Geography.** *President*—Major-General Strachey, F.R.S. *Secretaries*—H. W. Bates, E. C. Rye, F. F. Tuckett. **F. Economic Science and Statistics.** *President*—James Heywood, F.R.S. *Secretaries*—F. P. Fellowes, T. G. P. Hallett, E. Macrory. **G. Mechanical Science.** *President*—William Froude, F.R.S. *Secretaries*—W. R. Browne, H. M. Brunel, J. G. Gamble, J. N. Shoolbred. The President's Address will be delivered on Wednesday, August 25, at 8 p.m. On Thursday evening there will be a *Soirée*. On Friday evening, at $\frac{1}{2}$ -past 8, Mr. Spottiswoode will discourse on "The Colours of Polarised Light." On Saturday evening Dr. Carpenter will lecture to working men on "A Piece of Limestone." On Monday evening, the 30th inst., Mr. Bramwell will lecture on "Railway Safety Appliances." On Tuesday evening a second *Soirée* will be held, and on Wednesday, September 1st, the concluding General Meeting will be held.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 821.

THE COPPER-ZINC COUPLE AND ITS EFFECTS.*

By J. H. GLADSTONE, Ph.D., F.R.S.,
Fullerian Professor of Chemistry in the Royal Institution.

I PROPOSE, ladies and gentlemen, to bring before you in this lecture a series of researches which have been made during the past two or three years by Mr. Tribe and myself. They have been made partly in my own private laboratory and partly in the laboratory of this Institution. They are the work of what we call the copper-zinc couple, and my first duty, I think, will be to explain the principle of that couple.

We have here a simple galvanic cell: that is to say, we have two different metals, in this case copper and zinc, because I mean to keep to zinc and copper pretty much during this afternoon. At present the metals are not connected with one another except by that liquid. The liquid is dilute sulphuric acid. There is a magnet just taking up the ordinary position of the meridian. We have arranged it so that the magnet points towards the two metals, because that is the direction of north and south. Supposing I connect those metals by any metallic junction, such, for instance, as this other piece of zinc, we shall see that something takes place. That magnet, you see, is at once started, and swings round to one side considerably, and will remain permanently on one side, while, at the same time, you will observe there are bubbles of gas forming on the copper plate, and rising up to the surface of the liquid. I think that the contact has been broken for a moment. Now I will make it again, and you perceive that again this magnet swings, and the bubbles of gas rise upon this copper plate.

Now, how are we to conceive of this? There is no action taking place between this copper plate and the liquid in the way of solution. It is the zinc which is dissolving off; but, at the same time, this hydrogen which is being produced by the action of the zinc is actually given off at about 10 in. distance on the copper plate. That there is something going on is evidenced by the moving of the magnet. It is true that this magnet is affected by two things here, the liquid and the connecting metal. It may be affected by either, and at present it is being affected by both. Now, how are we to conceive of what is taking place under these circumstances in the liquid.

Well, we must have some kind of theory—some kind of view. It is very difficult for us to imagine exactly what is taking place; but still I endeavoured to illustrate it in the juvenile lectures by means of a moving diagram. Here is a diagram representing two plates, one of copper, and the other of zinc: these are supposed to be in metallic connection one with the other, and the liquid between them is subjected to some kind of strain, or tension, and therefore some kind of change takes place in it. Now, we believe that in the first instance the molecules—or little parts of which it is composed—arrange themselves in some particular order; that, in fact, the oxygen turns itself towards the zinc, and the hydrogen turns itself in the direction of the copper. What takes place? The oxygen, or the sulphuric acid—for it is sulphuric acid in the cell of which I have been speaking—combines with the zinc, and the zinc dissolves away and comes out into the liquid, and, at the same time, the hydrogen is deposited upon the copper. You may suppose that these

spots represent the hydrogen. The hydrogen is being deposited on the copper, and goes away. Then more hydrogen comes in occupying its place, because it is always passing on. This hydrogen passes away also; more hydrogen comes, and in the meantime the zinc is dissolved and is going into the liquid. The sulphuric element remains in about the same place, but there is constantly a passage of the hydrogen which is being thrown off. [The molecular changes were represented by means of the working diagram.]

We may go on in this way till all the hydrogen is expelled, and we have the whole liquid filled simply with a compound of zinc. Well, that is one conception that we may form of it. Suppose, instead of this, we take another—a somewhat crude contrivance. Here I have arranged a number of balls, which may represent the sulphuric acid and the hydrogen. These are the sulphuric element, and those are the hydrogen, and I have placed them alternately. Now we will suppose that a force is exerted here,—this galvanic force, or electro-motive force, or chemical force, whatever you please to term it. We will represent this force by the falling of a little ball. Then what happens? The force goes through the whole, and there is very little change at the first ball, but a considerable amount of change at the other end. The last ball flies out. I cannot go on with the experiment now, because I shall have to change the order of these balls. Well, I make that change, and then there is a fresh impulse given, and more hydrogen is sent off. [Illustrating.] This is a rough and very crude idea of what may be taking place in that liquid.

The whole amount of force that is capable of being generated by that zinc plate, and that copper plate, is not employed in the decomposition of that liquid, and I will point out to you where there are two sources of loss of force. If I make these metals touch together, at once we shall see that an action takes place, and our magnet swings. But these junctions are very imperfect indeed, and there is a certain loss of force in them. If, instead of taking a piece of metal like this I had taken a very long wire, as in our electric telegraphs, the loss would have been much greater. But that loss of force is nothing compared with another. It is what is called the external resistance. Sometimes it is very great, but in this case it is not great. But there is a loss of force in the liquid itself, by its resistance. The liquid does not yield readily to the strain. There is something—some power in the liquid itself which holds its particles together, and it will not be influenced at once or readily by the galvanic current that passes through. Now, this resistance varies with different liquids. With all it is considerable. Even with the dilute sulphuric acid which we have here it is very great indeed compared with what it would be if a metal were between the two plates. But suppose that, instead of taking sulphuric acid, I had taken pure water; it would have been very much greater. Supposing I had taken some organic liquid, such as alcohol, it would have been greater than in the case of water. Let me illustrate it in this way—very roughly indeed. Suppose that we are operating with this illustrative apparatus, and we take our force; what do we have? A certain effect produced at the other end. Away goes our ball to that distance. We will mark that distance. Well, now we will take balls of another substance. These are balls of another kind, which we may suppose to represent atoms of another nature; but we will employ the same force. These are wooden balls, and the others were some kind of porcelain or stoneware. We will employ the same force by means of this falling ball, which represents the electro-motive force; but now we have got a different material to deal with—a different material through which to send our shock; what will be the effect? Now, you see, the ball does not go to the same distance. You can easily understand that it depends upon the nature of these particular balls how far the force will be transmitted. It depends upon whether they are more or less elastic, and hence I

* Verbatim report of a Lecture delivered at the Royal Institution, London.

use this as an illustration of the amount of resistance that is offered by different liquids.

This resistance differs according to other circumstances. I think that we might show you that also. You will probably remember that when I took all these balls, and caused the force to be exerted through all of them, the ball at the end did not travel very far. I will repeat the experiment. I will cause the force to be exerted, and you will see the distance to which it sends the ball from the end. Supposing I take a much shorter distance, a smaller amount of material; we shall find that the same force will send the ball very much farther.

Well, now, I want to show you that with regard to water. I have here a little pure water in this vessel, and we want to arrange it so as to see whether distance—whether the length of the water—has not a great deal to do with this phenomenon. I take here the same metals which I have employed before—zinc and copper. I have wires joining them, and passing through this apparatus—this Thomson's galvanometer—which I need not explain to you now. What I want to draw your attention to is this—that a feeble current passes through that apparatus, and we are able to show the movement of a small magnet—a very minute, delicately suspended magnet—which is there, and which has a mirror upon it. The light from this lamp will be reflected from the mirror, and will be thrown upon the screen. We must allow the beam of light to come to rest. You see there it is, just at the edge of the screen, swinging backwards and forwards. Now I place these metals in the water: you perceive that it brings the beam of light to a certain distance. There is a certain amount of force going through the instrument, and it moves the beam of light away, bringing it fairly on to the screen. Now at present I have about 2 in. of distance of water. I will take about half that: you perceive that then the image of the mirror is brought farther on the screen. There is more action, more movement of the magnet. Supposing I bring it a little nearer still. Then you perceive that they come nearer and nearer to one another. As I advance, and bring them close to one another, you perceive that the image advances farther and farther. I will endeavour to bring them nicely close by the side of one another. There you see, the beam has advanced considerably from the edge. It is swinging backwards and forwards, it is true, but still it has considerably advanced. Now I will move the metals nearer, and you see that the beam has moved to a more advanced part of the screen. I do not think that I need push it further in order to show that the amount of distance in the water has a great deal to do with the amount of movement, and that the water offers a large amount of resistance. If I take only half the amount of water a larger amount of the current passes through, and thus the image travels farther along the screen. If I bring the two plates very close to one another, as I did in the last instance, we bring the image far on to the screen. I will do it again. There it goes with a good swing. This shows that we have a considerable amount of force.

Now, I want you to bear in mind very distinctly that this resistance varies very much with the length of the liquid that is between the two metals.

The virtue of our copper-zinc couple is that, by means of it we are able to get rid entirely of external resistance, and reduce the internal resistance of the liquid to the very minimum. We take zinc and we deposit copper upon it in a myriad of different places, and we immerse the whole in water, or any other liquid that we want to act upon. Then, of course, there is no external agent at all, because the whole thing is inside the water, or the liquid that is to be acted upon; and as to the distance of the water, the water will wet the whole thing. It will go all round the zinc and the copper and be acted upon. But I must show you that by means of the microscope. We will take some zinc, and show you how it decomposes the copper solution. It takes the place of the copper, and the copper is thrown down upon it. [A magnified

shadow of the vessel and preparation was thrown upon the screen.] There is the zinc, and there is the copper. The copper will pass out of solution and be deposited on the other pieces of copper already thrown down, and the zinc will dissolve.

We have already made some preparations. The copper is deposited slowly: and I think it would tire your patience if you were called upon to wait for it. Here is some that has been prepared a little while before the lecture, and it has grown. This black image is the piece of zinc, and here is the copper which is growing. Of course, you see only the shadow of the copper and the zinc in this instance, and hence the things appear black. This is not really black: it is red copper; but the shadow, of course, is black. You see these crystals that have grown out in various ways. Here is a piece of crystalline copper. See the graceful forms into which it has grown! Here are great masses of copper which have formed at the end of the crystals, and which have stopped the progress, as they generally do. There is the deep-coloured chloride of copper, and here are the crystals growing into it, and there are bubbles which are being formed. These two substantial crystals of copper are very like, in shape, the native metal that we get from Canada and elsewhere. I am sorry that I cannot show you the copper growing, but only some of the copper which has been formed. We will take another metal. Instead of zinc and copper we will take zinc and tin. The tin is deposited much more rapidly than copper is, and hence we can see it being deposited before our eyes, and growing. The zinc in the copper solution is now fringed with crystals, and there are bubbles and currents in the liquid, and these crystals of copper are certainly much larger and longer than when it was first placed upon the screen; but still, I will try to show the action with tin much more rapidly. You see the crystals shooting forth—very beautiful points darting forward in the liquid. These are crystals of tin which are being formed upon the zinc, just in the same way as the copper, of which I was speaking just now. You perceive they are gradually growing and pushing their way into the liquid. Let us try some other parts of the liquid—try the other side, and see how they are growing there. Look at this thread. It is growing gradually, and becoming thicker and thicker, with fresh crystals deposited upon it. I will call your attention to the formation of bubbles here. This made a start, just now, and pushed aside some of the crystals which were growing upon it. This is the thin thread of tin to which I alluded just now, and you see how it has grown and shot out this large vegetation of tin at the side of it. You perceive, therefore, this beautiful natural growth of the metal round about the zinc while the zinc is displacing the metals from their solution.

This so far, then, will illustrate to you that zinc is capable of turning out other metals from their solution, or, as we say, it has a greater affinity for the acid than these metals, for it dissolves away in the acid, and these metals remain. Now, suppose I were to take some sheet zinc, which I have here. I will take a piece of it and straighten it out. Now we will put that into a solution of sulphate of copper. I do not know whether we shall see it best by lamp-light or by daylight. Perhaps the daylight will show it best. As I put this into the blue sulphate of copper, you see at once that this bright zinc is losing its lustre. It is becoming grey; and as it goes down further you perceive that this portion which has been longest immersed becomes very black, and bubbles arise at the same time. The zinc is becoming covered with a black deposit of copper. Now we will allow that to go on before your eyes, and you perceive that it passes through a greyish colour into this black colour. This deposit is metallic copper, though perhaps you are not accustomed to think of metallic copper as black. We generally think of it as red; but its colour depends upon its state of division and upon other circumstances. I do not know why it is, but

I think I may fairly say that every metal, if formed sufficiently slowly and in sufficiently fine crystals, appears perfectly black; and this copper upon the zinc, as we make it for our zinc couple, appears of a velvety black, or nearly as black as velvet, which is the blackest of all blacks. It is what we saw magnified on the screen just now; that is to say, there are myriads of crystals of copper—similar crystals to those which I magnified. I purposely made the largest crystals I could; but there are myriads of crystals of copper all over the surface of this zinc, touching it at a great number of points; so that if we put it into water, or into any other liquid, the liquid will wet it all over, and get all among the crystals of copper to the zinc. We will allow this to remain until the end of the lecture, and I should not wonder if by that time the zinc removes all the blue colour from the liquid.

The way in which we make this couple, then, is to take a quantity of this zinc-foil and to pour upon it some sulphate of copper. The copper deposited has to be washed and dried. Generally speaking, we wash it by means of water, then by a little alcohol, and afterwards by ether. We dry it in the way which Mr. Williams will kindly show to us now. You are aware that ether is a very volatile substance, and it cannot be heated without very soon going away altogether, and therefore we warm it in an atmosphere of carbonic acid gas. When we begin to warm it, we first of all see that the ether is really going off, and then we light it in this way. [The jet of ether vapour which issued from the vessel in which the couple was being dried was ignited.] We can see when there is no more ether left by its ceasing to burn. Now during this time we are, of course, removing any extraneous substance. You recollect that the sulphate of zinc has already been washed away from the couple, and this ether is just to remove the last trace of water or of alcohol that may be employed.

We have now driven off nearly all the ether. Here is carbonic acid being produced, and it is bubbling through sulphuric acid in order to be dried, because we must use dry gas. The dry carbonic acid is taking the place of the ether. If we go on heating the flask more we shall find that a change takes place. Although there is not a great deal either of zinc or copper in that bottle, we can reduce its bulk by heating it, and then at a certain temperature the zinc becomes exceedingly brittle, and falls to the bottom. All this time dry carbonic acid is passing through. You see now that the metal is reduced considerably in bulk, because most of it is broken down into powder; and we can use this powder as we wish, and weigh it out as we want it. [A portion of the powder was removed from the flask.] There, you perceive, is the most intimate mixture of zinc and copper which one can well conceive. This is our zinc couple, and it is prepared to act upon any substance—to act like the zinc and copper plates, only there the copper and zinc were at about the distance of 10 inches; here they are touching one another—touching at myriads of points. There the zinc and copper had to be brought into connection by means of another piece of metal, while here they are already in connection with one another. They are touching one another, and the liquid is touching them, so that instead of having one large cell with a large amount of resistance, we have a cell in which the resistance is reduced to an infinitesimal quantity, because the liquid completely surrounds the two metals, touching them at the points that are most important—the points of junction. Hence the power of the two metals, whatever we call it,—the chemical power or the electromotive power,—is exerted at the best possible advantage.

We may now take substances like water or chloroform, which offer a very great resistance, and, by using this metallic powder, tear them asunder better than with all the batteries that can be invented—better than by all the galvanic apparatus which are in this institution, or in any of the institutions in London.

(To be continued)

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Lecturer on Chemistry at Sheffield School of Medicine; Public Analyst for North Derbyshire and the Borough of Sheffield.

(Continued from vol. xxx., p. 117.)*

IV. BUTTER.

ALTHOUGH the number of the constituents of butter is but small, and their nature has long been well understood, the examination of butter for the detection of adulteration is surrounded with peculiar difficulties, the principal of which has only been overcome quite recently.

As commonly sold, butter consists of the fatty matter of the milk of the cow, together with very variable quantities of salt, water, and the different constituents of milk. Genuine butter should be composed wholly of the above constituents, and all other substances (except, perhaps, harmless vegetable colouring matters) must be regarded as adulterants.

But it does not follow that butter which only contains the usual ingredients is necessarily unadulterated in the proper sense of the term. The presence of excessive proportions of curd, water, or salt must be denounced.

In the process of making butter, it is usual to wash the separated fat with water, to free it as much as possible from buttermilk, &c., though in some cases this process is omitted, and the aqueous portion of the butter is practically the serum of milk. A small proportion of casein or curd must be considered a normal constituent of butter, but it is said to be sometimes employed as a vehicle for an excess of water. The same remark applies to salt.

The proportion of water in well made butter is generally about 8 or 10 per cent; it ought not to exceed 12 or 13 per cent. The proportion of salt varies greatly according to the character of the butter, the amount in fresh butter being often less than 1 per cent, while in good salt butter it amounts to from 5 to 8 per cent. Any proportion greatly in excess of the latter amount is suspicious, and if it exceed 10 per cent, special notice should be taken of it. The curd consists of the caseous matter of the cream, and must be considered as a decidedly objectionable constituent of butter, as its presence promotes decomposition. Butter which has been completely freed from casein and membrane by fusion may be kept unaltered for years. The proportion of curd in butter should not exceed 5 per cent. If sensibly in excess of this amount, it should be considered as an adulterant, as it has probably been left in or added with the view of causing the butter to retain more water.

It is evident that the question of adulteration of butter by excess of water, curd, or salt is dependent on the aggregate amount of the three, or, in other words, upon the percentage of real butter-fat present in the sample. This, in genuine butter, is less variable than might be supposed. In twelve genuine butters from different sources, Messrs. Angell and Hehner† found an amount of fat varying from 78.491 to 90.197. With one exception, there was no butter which contained less than 83.68. The average of the twelve was 85.45 per cent of fat. The above estimations appear to have been made indirectly, by subtracting the sum of the percentages of water, curd, and salt from 100.000.

The Society of Public Analysts has adopted 80.00 per cent as the lowest limit of fat contained in a genuine butter.

The amount of *water* is best ascertained by heating 5 grms. of the butter in a small weighed beaker to a temperature of about 110° or 120° C. for an hour or so. Some chemists merely heat the butter on a water-bath. Accord-

* The Author regrets that indifferent health and professional engagements have together caused the lapse of so long an interval of time since the appearance of his late article. He hopes to avoid similar delay in the future.

† "Butter and its Adulterations," pp. 12 *et seq.*

ing to my experience, perfect drying is next to impossible at that temperature.

It has been proposed to estimate the water by measurement after melting a weighed quantity of the butter in a graduated tube. This exceedingly simple method, which answers perfectly with lard, is useless in the case of butter, in consequence of the casein floating between the melted fat and the water, and rendering it impossible to observe the line of demarcation. I have tried several varieties of the proposed method with uniform failure. The ingenious plan of Hoorn,* who uses petroleum ether, fails for a similar reason. Solution of the butter in ether, with subsequent addition of petroleum ether (commercial "benzolene"), answers somewhat better, but is unsatisfactory. The estimation of the water in butter by drying is the only known method which, according to my experience, is capable of giving reliable results.

The dried butter is next treated in the beaker with anhydrous ether or commercial benzolene. The former liquid is expensive and inconveniently volatile, while it must be used in a perfectly anhydrous condition (to avoid solution of the salt), and, except when boiling, has but a limited solvent power for butter, especially when adulterated. Benzolene dissolves fats more readily than ether; it does not volatilise so rapidly at ordinary temperatures, it is always anhydrous, and has the advantage of low price. The "benzolene" I employ is made by re-distilling the commercial article from a retort immersed in a bath of boiling water. About one-third of the original bulk usually comes over readily at 100° C., and has a gravity of 0.689.

On warming the beaker containing the benzolene, the dry butter readily dissolves. The liquid is poured on a small dry filter, and washed with warm benzolene, the filtrate being collected in a small wide beaker.

If the filter had been previously weighed, its increase of weight, after careful drying, will of course give the quantity of *curd and salt* in the 5 grms. of butter taken. Except in cases in which extreme accuracy is desired, I prefer to scrape the residue off the filter, and weigh it separately.† The error (owing to imperfect removal) only amounts to one or two tenths per cent of the butter taken. As the salt is accurately estimated afterwards the loss falls on the curd. The *salt* may be determined by careful ignition of the filter and residue, the incombustible matter consisting almost wholly of common salt, while the *curd* is ascertained by the loss of weight. This method is not to be recommended, for, without great care, some of the salt will be volatilised and lost, the error causing the amount of curd to appear excessive.‡

Ignition also renders any further examination of the curd an impossibility. A far preferable plan is to return the weighed curd and salt to the filter, and to wash them with cold water. The filtrate is made up to 100 c.c., and the salt estimated in half of it by titrating with decinormal nitrate of silver. The remaining portion of the solution can be employed for the estimation of *sugar* if desired. This is effected by inverse titration with Fehling's copper solution in the same way as grape-sugar.

The estimation of sugar may sometimes be of interest as a means of ascertaining whether the aqueous portion of the butter consisted of mere water or of serum of milk. In other words, the estimation of the sugar may furnish a means of ascertaining whether an excess of water in the butter is due to insufficient removal of the buttermilk, or to subsequent incorporation of water. Every 0.001 gm. of milk-sugar represents about 0.022 of average milk serum.

The residue insoluble in cold water usually consists almost wholly of *casein*. If, however, the butter has been

adulterated with mashed potatoes, flour, or other *starchy matters*—said to be occasionally employed—they will be found here. The presence of starch in the residue will, of course, be readily indicated by treating it with hot water, and testing the cooled liquid with solution of iodine. Starchy matters can also be detected by stirring up the butter itself with solution of iodine. By pressing out a small portion of the butter between two slips of glass so as to obtain a thin film, and observing it under the microscope (or by observing the caseous residue after treatment with cold water), the nature of the starch may be ascertained.

The solution of the fatty matter in benzolene is evaporated at 100° C. till it no longer decreases in weight. The average proportion of *fatty matter* in butter is about 85 per cent. If less than 80 per cent, the butter must be considered adulterated. It is evident that a careful estimation of the percentage of fatty matter would often render separate estimations of the water, curd, and salt unnecessary, for unless the sum of the three latter constituents exceeded 20 per cent the butter could not be considered as adulterated, unless by an admixture of other fats.

An easy and rapid method of estimating the fat in the undried butter is therefore a great desideratum, but, unfortunately, no satisfactory method is at present known. I have tried a plan which seemed exceedingly promising, and which consisted in merely treating the butter with petroleum ether, filtering, and evaporating the solution of the fat. The process was a failure, owing to the fact that the water passed through the Swedish filter employed, even where the latter was thoroughly drenched with benzolene.*

The indirect estimation of the fat, by subtracting the sum of the percentages of water, curd, and salt from 100.00, ought to agree with the direct estimation of the fat within 0.5 per cent, and the variation is often much less.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.†

By Dr. A. W. HOFMANN.

(Continued from p. 65.)

THE discovery made known by Schönbein, according to which the peculiar phosphorous odour accompanying the electrolysis of water was due to the evolution of oxygen in a state possessing heightened oxidising properties, was received with great expectations, both in medicine and arts. Schönbein named this oxidising principle ozone (from *ὄζειν*, to smell), and he perceived its evolution, as Van Marum had already done in 1785, at least, as far as the odour is concerned, near the conductor of an electric machine when in action. He discovered subsequently that it was produced also during the slow combustion of phosphorus, and that it was present in the atmosphere in very perceptible traces. Observations of its occurrence increased very rapidly. Schönbein and others found that the peroxides of silver, barium, and hydrogen, in contact with sulphuric acid, evolved oxygen more or less strongly ozonised, the same property belonging also to the manganate, permanganate, and (according to Rammelsberg) the periodate of potash. The agitation of air with mercury, or with the precious metals in a state of fine division, or with powdered glass,‡ was also found

* *Zeitschr. Anal. Chem.*, vol. xi., p. 334; and *Journ. Chem. Soc.*, 1873, p. 1064.

† The removal of the residue from the filter presents no difficulty if the butter has been properly dried. In the presence of water it is impracticable.

‡ Dr. Tidy estimates the salt by igniting the butter itself. This method is still more liable to error from volatilisation unless great care is taken.

* A similar, but reverse, action has been observed to occur if the insoluble fatty acids from butter be washed with boiling water on a Swedish filter provided with a hot-water jacket, the fats passing through the wet filter simultaneously with the water. At a slightly lower temperature, such as obtains in practice by omitting the water jacket, no such effect is observed.

† "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

‡ Andrews, *Nature*, 1875, p. 365.

to be a means of ozonisation. The ethereal oils, especially oil of turpentine, display this property in a high degree. Ozone was detected in the air current from a furnace-blast and in the oxygen expired by plants.

The means for its detection, in addition to the fact that 1 part of ozone imparts its peculiar odour to 500,000 parts of air, were found in the following reactions:—

Ozone liberates iodine from iodide of potassium, iodic acid and potassic peroxide being simultaneously formed, and the solution, after the removal of the iodine, has an alkaline reaction. The presence of the free iodine is easily demonstrated by means of moist starch-paper, and the potash, or potassium peroxide, by litmus. Ozone bleaches indigo and colours freshly-prepared tincture of guaiacum a deep blue, turns paper brown which is saturated with salts of manganous oxide or thalious salts by the formation of higher oxides, oxidises mercury at ordinary temperatures, and converts silver into black silver peroxide. Paper saturated with thalious oxide and exposed to ozone blues tincture of guaiacum, potassium-iodide, and starch before it turns brown. It was sometimes forgotten that the reactions with indigo, guaiacum, and iodide of potassium and starch are produced also by chlorine, nitrous and hyponitrous acid, and hence phenomena have been ascribed to ozone which were really due to one or other of these bodies.

Concerning the nature of ozone, opinion fluctuated for a long time. More than one eminent chemist held that it contained hydrogen. Marignac and De la Rive maintained the opposite view, which was finally demonstrated by Soret in 1863. The reason of the difference between ozone and ordinary oxygen became gradually intelligible. The first step was furnished by the observation of Andrews and Tait that ozonised oxygen if heated to 270°, was converted into common oxygen, increasing at the same time in volume, and that ordinary oxygen, if ozonised by silent electric discharge decreased in volume. This decrease in bulk corresponds to the quantity of the active oxygen absorbed by potassium iodide, so that if the volume, on

ozonisation, is decreased by $\frac{1}{n}$, then $\frac{1}{n}$ of the ozonised oxygen is absorbed by solution of potassium iodide. Ozone, therefore, appears indubitably as condensed oxygen. Odling's hypothesis that this condensation amounts to one-third, and that the molecule of ozone is larger by the half than that of ordinary oxygen, its molecular weight being $O_3=48$, that of common oxygen being $O_2=32$, was approximately proved by Soret in 1865, and decidedly demonstrated by Brodie in 1871.* Soret added the discovery that ethereal oils, especially oils of turpentine and of cinnamon, absorb the whole amount of the ozone formed; consequently, not $\frac{1}{n}$, but $\frac{3}{n}$.

(To be continued.)

COAL IN RUSSIA.

(ANALYSES OF SOME SAMPLES).

By SERGIUS KERN, St. Petersburg.

IN the CHEMICAL NEWS (vol. xxxi., p. 133) I gave some analyses of Russian coals; I suppose a further description of some other samples may be of some interest.

Government Toula.—

1. Village Kievtzi on the river Oka; 3000 calorific units; 3.07 per cent of sulphur:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 22.54 |
| Volatile matter | 27.78 |
| Ash | 49.68 |
| | 100.00 |

* Brodie, *Proceedings of the Royal Society*, vol. xx., p. 472, 1872; Odling, "History of Ozone," *Proceedings of the Royal Institution*, 1872.

2. Village Krasni Cholmi; 4000 calorific units:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 52.00 |
| Volatile matter | 31.32 |
| Ash | 16.68 |
| | 100.00 |

3. Village Vialino in the Odoievsky district; 4000 calorific units; 2.13 per cent of sulphur:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 39.68 |
| Volatile matter | 52.40 |
| Ash | 7.92 |
| | 100.00 |

4. Village Malëvka in the Bogoroditsk district; 3500 calorific units; contains 32 per cent of hygroscopic water:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 34.88 |
| Volatile matter | 42.76 |
| Ash | 22.36 |
| | 100.00 |

Government Kalouga.—

5. Village Zelenino; 3560 calorific units; absence of sulphur:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 30.35 |
| Volatile matter | 48.36 |
| Ash | 21.29 |
| | 100.00 |

6. Village Znamensky in the Likhvin district; 4200 calorific units; fresh coal contains 20.05 of hygroscopic water:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 35.70 |
| Volatile matter | 44.24 |
| Ash | 20.06 |
| | 100.00 |

Government Ekaterinoslaw.—

7. Near the Village of Mr. Illovaïski; calcined, leaves 74.70 per cent of compact coke; 6900 calorific units; sp. gr. 1.26; 10,600 cubic feet of gas per ton:—

| | Per cent. |
|---------------------------|-----------|
| Carbon | 72.22 |
| Volatile matter | 24.47 |
| Ash | 2.48 |
| Hygroscopic water | 0.83 |
| | 100.00 |

Government Simbirsk.—

8. Near the town Sysrane on the river Volga; 3500 calorific units; bad coal:—

| | Per cent. |
|---------------------------|-----------|
| Carbon | 17.20 |
| Volatile matter | 37.30 |
| Earthy matter | 28.40 |
| Hygroscopic water | 17.10 |
| | 100.00 |

Caucasus.—

9. On the rivers Coubane and Choumar; the coal gives compact coke; 7000 calorific units:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 58.85 |
| Volatile matter | 37.99 |
| Ash | 3.16 |
| | 100.00 |

Donetz Mountains.—

10. On the river Bolshaia-Nesvitaia; good anthracite; 7600 calorific units; 0.27 per cent of sulphur:—

| | Per cent. |
|-------------------------|-----------|
| Carbon | 93.27 |
| Volatile matter | 4.92 |
| Ash | 1.81 |
| | 100.00 |

SOCIETY OF PUBLIC ANALYSTS.

THE "Sale of Food and Drugs Act, 1875," received the Royal Assent on the 11th inst., the whole of the amendments introduced by the House of Lords being at length accepted by the Commons. We hope at an early date to publish a short *resumé* of the Bill, pointing out its probable working, and the necessary changes and modifications in the machinery.

A NEW DEFENCE FOR MILK ADULTERATORS.

RECENTLY, in a prosecution for milk adulteration, instituted on the certificate of Mr. W. Morgan, Ph.D., the Public Analyst for the Borough of Swansea, the adulteration was denied; and, in explanation of the poverty of the milk, it was urged that it had been taken from a cow a few hours only after she had been milked dry. This being a new line of defence, Mr. Morgan instituted a series of experiments for the purpose of ascertaining whether, under even the most trying circumstances, the "solids not fat" would fall below the Society's standard.

The tabulated results of Mr. Morgan's experiments we print below, feeling sure they will be of interest to all engaged in milk analysis.

It may be well just to mention that the cow was kept indoors during the time these experiments were being performed; that it was fed chiefly on brewer's grains, together with a little barley meal, &c.; that it was an ordinary black cow, the worst the dairyman had; that it had calved about six months previously; that the udder was in each case exhausted; and that all the milkings were done in Mr. Morgan's presence.

| Date. | Hour of Milking. | Total Quantity. | Per centge. of Cream after 24 hours. | Total Solids. | Fat. | Solids not Fat. | Ash |
|-----------|------------------|-----------------|--------------------------------------|---------------|------|-----------------|------|
| July 6 .. | 6.30 a.m. | 7½ pints | 13 | 12.84 | 2.96 | 9.88 | 0.63 |
| " " .. | 7.30 " | 6 ozs. | 37 | 17.60 | 8.00 | 9.00 | 0.65 |
| " 17.. | 6.30 " | 7½ pints | 13 | 12.68 | 3.48 | 9.20 | 0.73 |
| " " .. | 8.30 " | 6 ozs. | 33 | 16.56 | 7.00 | 9.56 | 0.67 |
| " 18.. | 6.45 " | 7½ pints | 14 | 13.16 | 3.78 | 9.38 | 0.73 |
| " " .. | 9.45 " | 4 ozs. | 24 | 15.23 | 5.89 | 9.34 | 0.72 |
| " 19.. | 6.30 " | 7½ pints | 15 | 13.15 | 3.62 | 9.53 | 0.64 |
| " " .. | 10.30 " | 2 " | 21 | 15.41 | 5.46 | 9.95 | 0.72 |
| " 20.. | 6.30 " | 8 " | 12½ | 12.59 | 3.13 | 9.46 | 0.63 |
| " " .. | 11.30 " | 2½ " | 17 | 14.31 | 4.51 | 9.80 | 0.70 |
| " 21.. | 6.45 " | 6 " | 10 | 12.70 | 3.10 | 9.60 | 0.68 |
| " " .. | 12.40 p.m. | 2 " | 15 | 14.20 | 4.32 | 9.88 | 0.73 |
| " 22.. | 6.30 a.m. | 6 " | 15 | 13.29 | 3.70 | 9.59 | 0.80 |
| " " .. | 1.30 p.m. | 3 " | 17 | 14.48 | 4.90 | 9.58 | 0.70 |
| " 23.. | 6.45 a.m. | 7½ " | 12 | 12.60 | 3.03 | 9.57 | 0.80 |
| " " .. | 2.45 p.m. | 3½ " | 15 | 13.82 | 4.54 | 9.28 | 0.75 |
| " 24.. | 6.45 a.m. | 7½ " | 12 | 12.62 | 3.24 | 9.38 | 0.72 |
| " " .. | 3.35 p.m. | 4½ " | 20 | 13.53 | 4.10 | 9.43 | 0.69 |

The above table shows that the eighteen milkings yield the following results:—

Total Solids—

| | | |
|-----------|---------|-------|
| Highest* | .. .. . | 17.60 |
| Lowest .. | .. .. . | 12.59 |
| Average.. | .. .. . | 13.93 |

Fat—

| | | |
|-----------|---------|------|
| Highest* | .. .. . | 8.60 |
| Lowest .. | .. .. . | 2.96 |
| Average.. | .. .. . | 4.41 |

Solids not Fat—

| | |
|-----------------|------|
| Highest | 9.95 |
| Lowest* | 9.00 |
| Average.. .. . | 9.52 |

* These being from the same milk.

THE next ordinary meeting will be held in the Museum and Library, Bristol, on Thursday next, the 26th inst., at 4 o'clock p.m. Papers on various subjects will be read and discussed, and the "Sale of Food and Drugs Act" will be fully considered.

NOTICES OF BOOKS.

How to Teach Chemistry, being the substance of Six Lectures Delivered at the Royal College of Chemistry in June, 1872, by E. FRANKLAND, F.R.S., &c. Summarised and edited by G. CHALONER, F.C.S., Lecturer on Chemistry at the Birkbeck Institute. London: J. and A. Churchill.

WE have often had occasion to notice the number of elementary works on chemistry issued from the English press—a supply rather disproportioned in amount to our quota of original investigation. Indeed, we half fear the time may come when the production of some such "manual" or handbook will rank as a matter of course among the youthful indiscretions of every man of culture. Some of these treatises may deal mainly in facts, whilst others indulge more largely in theory. Some may regard chemistry mainly as a field for the display of an ultra-sesquipedalian terminology, whilst some hold that a chemical compound, like a rose, will "smell as sweet by any name," and designate every substance by the briefest combination of letters needful for its identification. But beneath all these surface diversities there necessarily lies a mass of matter incontrovertible—if anything may claim such a title—and common to all. Hence, there remain for the critic merely questions of arrangement, or of lucidity of exposition, and he is often at a loss to imagine why nine out of every ten such books were ever written.

The treatise before us takes, however, a higher aim. It is addressed, primarily, not to the student, but to the professor. It instructs him *how* to teach chemistry; or, if we may so word it, what to teach as chemistry. This is really a point of no small moment. A most profound chemist may be injudicious in his way of imparting knowledge to others. Further, in these days, we learn, as was recently stated on high authority, "not to know, but to pass." Now, it is quite possible that a chemist, especially if of original and independent mind, may overlook this circumstance. He may forget that science, like millinery has its fashions, and like politics, its party-shibboleths and he may hence find that his pupils fail to pass to his own discredit and to their disadvantage. Hence, it must be admitted that a work like the one in question has an indisputable value.

As an important feature we notice a collection of "systematic names," and of "trivial names" placed in parallel columns. We have often thought that a dictionary of chemical terminology is fast becoming one of the wants of the age. But we cannot congratulate the authors on the manner in which the idea has been carried out. Their "trivial" names are a mixture of systematic names not now in fashion, of alchemical, pharmaceutical, and trade terms, and of the scientific names of mineral species, all used indiscriminately. Thus, malachite is given as the "trivial" synonym for cupric carbonate. We hope that the science-teachers for whom the book is intended are aware that malachite is the mineralogical name of one particular form in which cupric carbonate occurs in nature. In like manner spathic iron-ore is here given as a trivial synonym for ferrous carbonate, silver

glance for argentic sulphide, and white lead ore for plumbic carbonate.

Again, we find *saleratus* (? *saleratum*) given as synonymous with hydric potassic carbonate. *Saleratus*, *salaratus*, or *saleratus* is a word not in vogue in England, but when used it is applied—as it generally is in America—to the salt lately known as bicarbonate of soda. In like manner *salenixum*, though once used for hydro-potassic sulphate (bisulphate of potash), is now commonly applied to sulphate of soda, and is corrupted by the dyers into “Sally Nixon.”

The following passage is worthy of notice:—“It is remarkable how students at the May examination, 1870, misunderstood the first question in the paper: ‘You have given to you some sulphur, water, and nitric acid; describe how you would make sulphuric acid from these materials?’ The question obviously (?) referred to the oxidation of sulphurous anhydride by means of nitric acid. Yet the majority of the candidates who attempted it gave a long account of the manufacture of sulphuric acid, with all the details which they could recollect of the lead in chambers, &c. This gives a striking illustration of the necessity of intelligence as well as information to enable a student to come out well in an examination. Not only ability to *answer* a question, but to *understand* it first is wanted.”

The ability to answer a question unless it is first understood seems to us somewhat rare. But should not examiners seek to put their questions in language not susceptible of a double meaning? If from loose and vague habits of thought on their own part or from a latent desire to puzzle they utter ambiguities, they commit a grievous wrong. A chemical examination should test the standing of the student in chemistry, and not his power of guessing ancient oracles or modern conundrums.

*Programme of the Royal Rhenish Westphalian Polytechnic School at Aachen for the course 1875-76.** Aachen: J. J. Beaufort.

WHILST we in England are disputing about the best means of imparting a mere elementary education, or rather how such an education may be made to subserve the ends of certain classes and certain parties, Germany, more fortunate, or more prudent, is, in institutions like the Polytechnic School of Aachen, training up inventors and discoverers, or, to say the least, improvers. In other words, she is placing sound instruction in the scientific principles which underlie the arts and manufacturers within the reach of all. If the greatness, the wealth, and the progress of nations depends in the last resort, upon invention and discovery, Germany possesses in such schools the springs of a power more redoubtable even than her armies.

The Polytechnic School of Aachen was opened in October, 1870, for the purpose of affording “a comprehensive theoretical and practical training to young men who wish to devote themselves to technology, especially to machine making, the chemical trades, metallurgy, engineering, and architecture.” Recognising the necessity for a division of labour, and seeking to develop thorough specialists, “*männer vom fach*,” rather than “Jacks of all trades and masters of none,” the college does not compel all its students to pass through one and the same stereotyped course of education. It has a separate curriculum for the engineer, the metallurgist, the chemist, &c. As regards the facilities offered we may mention that in the chemical laboratory there is room for 110 students to work. In addition to the scope thus afforded for practice in analysis and in original research,—which is encouraged—there are courses of lectures, not merely on pure chemistry, organic and inorganic, on analytical chemistry, technical chemistry, on arranging chemical works, but on the polarisation of light, on spectrum-

* *Program der königlichen rheinisch westfälischen Polytechnischen Schule zu Aachen für den Cours 1875-76.*

analysis, on theoretical chemistry, on sacchari practical training, on the analysis of coal-gas, on chemistry and toxicology, on brewing, on the manufacture, and on dyeing and calico-printing. Further arrangements are made for the students to visit eminent chemical works. Thus, during the past year excursions were made to the sugar-works of Cöln, Düren, and Elsdorf; the breweries of Aachen and Dortmund, the glass-works of Stolberg, Cöln, Aachen, and Herzogenrath, the tar-works of Mülheim, the mirror-works of Stolberg and Herzogenrath, the anilin-colour works of Elberfeld, the silk-dye works of Crefeld, &c.

The question now arises, What is the cost of a scientific training so comprehensive and so thorough, conducted by professors of tried merit? As closely as we can calculate, if the student attends the greatest possible number of lectures and lessons, he will pay, for the term of ten months, from October to the end of July, fees amounting to 180 marks or about £9. If we add to this £2 5s., the yearly charge for working in the laboratory, we find the whole college expenses more than covered by the sum of £12 yearly. Have we any establishment in England where similar advantages can be obtained for five times that amount? Surely such facts must go far to explain how it is that leading positions, not merely in our colleges, but in our manufacturing establishments are being filled by foreigners, to the exclusion of natives. Is there no “Cassandra” to enlarge on this theme?

Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. Revised and enlarged by Prof. TH. RICHTER, (Royal Saxon Mining Academy, Freiberg). Edited by T. H. COOKESLEY. London: Chatto and Windus.

OUR opinion on the merits of Plattner's great work has been often enough expressed. But when we remember the existence of two formal English versions of the manual—those of Muspratt and Cornwall—to say nothing of sundry adaptations and abridgments, we can only say that we hope the editor and publishers will not be disappointed in their expectations. Mr. Cookesley informs us in his preface that he has followed generally the translation of the American edition, omitting some few portions which he thought superfluous, such as the lists of minerals given under each heading.

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—In reference to the observations on this subject by my friend Mr. Readwin, published in the *CHEMICAL NEWS* (vol. xxxii., p. 71) I crave permission to call attention to a slight oversight. The writer asserts that in this country we “never had a distinctive Society of Mineralogists.” It may therefore be worth while to mention that a “British Mineralogical Society” existed in the early part of this century, although its history appears to be not generally known. The original minute book is, however, preserved in the Library of the Royal School of Mines, and the origin of the Society is set forth in the first entry as follows:—“At a meeting held in the Askesian Society's room, Plough Court, April 2, 1799; present, Wm. Allen, W. H. Pepys, Alex. Tilloch, Rd. Knight, and Wm. Lowrey. Resolved that those present do form themselves into a Society under the denomination of the British Mineralogical Society.” On this resolution action was at once taken, and the Society was founded. From the minutes of the fortnightly meetings it is clear that the members, though few, were banded together for real work. Minerals were received by the Society, and distributed

The members, who were compelled, under penalty of fine, to examine them and report the results to the Society. In this way a good deal of original work was done; but it appears that pure mineralogy was not sufficient to keep the Society in healthy activity, and admission was consequently given to subjects relating to general chemistry and even to geology. It must be borne in mind, however, that in those days there was neither Chemical nor Geological Society. After about the fifth year of its existence, the minutes of the Mineralogical Society became less interesting, and its life was slowly ebbing away, so that we are not surprised to find the following minute recording the close of its individual history:—"London, December 18, 1806; present, Wm. Allen, Rt. Bingley, Rd. Phillips, Rd. Knight, W. H. Pepys, and Thos. Cock. The Committee appointed to confer with the Askesian Committee having recommended the union of the two societies (*sic*) as advantageous to each in their design of promoting philosophical research, it was resolved that the societies be incorporated, which W. H. Pepys was desired to communicate to the Askesian Society."—I am, &c.,

F. W. RUDLER.

London, August 16, 1875.

LEAD IN DISTILLED WATER.

To the Editor of the Chemical News.

SIR,—Some time ago I fitted up a small glass apparatus for distilling water, using a piece of 2-inch English glass tubing for a condenser. After six or eight months the distilled water obtained was found to contain large quantities of a lead compound in solution, and on examining the condenser I found it encrusted with crystals of a basic plumbic carbonate. The English glass tube was found to contain a large quantity of Pb existing as silicate. Under the combined influence of steam and CO₂ at an elevated temperature this plumbic silicate was decomposed; formation basic carbonate and separation SiO₂. The basic carbonate then dissolved in the water (which contained CO₂) as it condensed.—I am, &c.,

W. C. PARSONS.

CALCULATION OF THE PROPORTION OF LIME IN MORTARS.

To the Editor of the Chemical News.

SIR,—In your notice of Major Ross's work on "Pyrology" there is an extract which is likely to give incorrect notions as to the composition of the mortar used in Indian Government buildings. If, as is probable, the 8 or 9 per cent of lime in the mortar of the Agra barracks, and the 5 per cent in that of the Allahabad building, are percentages by weight, the statement requires some remarks before presentation to persons not practically acquainted with the preparation of mortar.

I may first remark that mortar being invariably made with sand and lime can hardly be described as "mud." And a contractor intending to cheat in the matter of lime will take care that the sand shall be real sand; for an engineer who is not very knowing in the matter of lime will probably be inversely particular in seeing that the sand is "sharp and clean." It is also hinted that to the use of "kunkur mortar" is to be ascribed the ruin of many millions worth of public buildings.

Now this "kunkur," from which lime is nearly always obtained in the interior of India, is a conglomerate limestone formed by the hardening and crystallisation of carbonate of lime deposited from water. It may be nearly pure hard chalk, or it may contain as much as 30 per cent, or more, of sand, clay, disintegrated gneiss, &c. When clayey, and of decidedly nodular structure (resembling somewhat the *septaria* from which Roman cement is made) it yields, on burning, a lime which, under proper treatment, is of excellent hydraulic quality. The proportion

of clay and other impurities is always much greater than in an European limestone of equal hydraulic quality. The proportion of impurity increases of course when the stone is burnt: a limestone containing 20 per cent will yield a lime containing 30 per cent. A good and typical kunkur lime, fresh burnt, was found to contain—

| | | | |
|-----------------------------|---------|------|-----------|
| Silicates (sand, clay, &c.) | .. | 40.0 | per cent. |
| Unburnt carbonate of lime | .. | 8.8 | " |
| CaO | .. .. . | 51.2 | " |

This lime, so impure as to contain only one-half of real CaO, yet was of excellent hydraulic quality. A paste or a mortar made with it set (*i.e.*, supported Vicat's needle) under water in four days. The lime on being slaked increased one half, its specific gravity in bulk diminishing from about 1 to 0.67.

The engineer will probably be satisfied if 1 volume of the slaked lime be mixed with 2 volumes of sand (of which the specific gravity is 1.5); we shall thus have as the composition of the mortar, calculated on the dry materials—

| | | | |
|------------------------|-------|------|-------------------|
| 1 vol. lime, weighing | .. .. | 0.67 | { 0.33 silicates. |
| 2 vols. sand, weighing | .. .. | 3.00 | { 0.34 lime. |
| | | 3.67 | |

So 3.67 parts by weight of dry mortar contain only 0.34 part, or somewhat under 10 per cent of real CaO. I have not made any allowance for increase of weight in slaking or for absorption of carbonic acid by the mortar in drying, both of which would tend to diminish the proportion of lime.

Now this mortar, yielding on analysis less than 10 per cent of lime, will be of excellent quality if properly made, and mortar, like paint, requires to be mixed with brains. Bricks united with it, and placed *at once* under water, will be found, after one month's immersion, to adhere with a strength of at least 15 lbs. per square inch, the brick itself ripping under a strain of little over 20 lbs. per square inch.

Supposing that the mortar has been made from a good fat lime containing not more than 10 per cent of impurity, and swelling to double its volume on slaking, the composition would have been—

| | | |
|------------------------------|-------|-------------------|
| 1 vol. slaked lime, weighing | 0.50 | { 0.05 silicates. |
| 2 vols. sand, weighing | .. .. | 3.00 |
| | 3.50 | { 0.45 lime. |

This mortar will contain, then, in 3.50 parts 0.45 part actual CaO, or about 13 per cent: it would appear most satisfactory to the engineer, but bricks united with it would yield at a strain of about 4 lbs. per square inch, and it would be absolutely devoid of hydraulic properties. Indeed, for dry work, bricks, laid in mud and the joints neatly pointed, would be rather stronger than bricks in this mortar; and no increase in the proportion of lime would be of the slightest advantage.

In fine, a mortar found to contain rather less than 10 per cent of actual lime in the dry materials may be of excellent quality, while one containing 13 per cent, or even 25 per cent, might be very bad. It is on the quality of the lime used for the mortar, and not on the quantity of CaO contained in it, that the strength of the mortar depends. Analysis alone will rarely give any trustworthy indications on this point.

I have no doubt that the bad quality of mortar has had much to do with the ruins to be found in Indian cantonments. I have myself seen a costly public building condemned as dangerous, and pulled down, before it had been put to any use. But I think I have shown that there are different kinds of bad quality, and low percentage of CaO is not the only one—deficiency of mortar itself and the use of fat lime are quite as great faults. The first two these defects are part and parcel of the "scamped" work which so often occurs under the contract system of building in India; nothing but superintendence by vigilant and

incorruptible overseers will prevent them; the last defect has been under the attention of the Indian Government. I was engaged for two years in an inquiry on the subject, and the results may be found embodied in the Madras Government Orders, P.W.D., February 21 and December 10, 1874. The details of the inquiry are mostly too technical for reproduction in your columns. I will only state that in publishing my reports the Madras Government "anticipate that a marked improvement in the selection and preparation of cements and mortars for different descriptions of public works will result."—I am, &c.,

EDWARD NICHOLSON.

Carlisle Castle, August 9, 1874.

THE PYROXIDATION OF SILVER.

To the Editor of the Chemical News.

SIR,—I ought to be, and am, the last to cavil at any expressions of the able, candid, and, at the same time, generous review of my lately-published book, "Pyrology, or Fire Chemistry," which appeared in the CHEMICAL NEWS, vol. xxxii., p. 59, but it seems to me that a citation from the former in the latter is the result of a misapprehension.

I refer to this sentence:—"In a subsequent portion of the work, the author remarks that the volatility of silver at high temperatures is not unknown in Germany. We can assure him that, among assayers and metallurgists, it is not unknown in England also."

Now, on referring to my book (page 248 *et seq.*), it seems to me that my remarks of that complexion were made with reference, not to the *volatilisation*, but the *pyroxidation* of silver. I admit that there is some confusion existing between the use of these two terms, and even that it is somewhat apparent in the article on silver in my work; but it is not due to me, the latter term having never, so far as I am aware, been employed at all before I used it.

Yet it is evident that these terms are by no means synonymous. Mercury, for instance, is volatilised by the most moderate heat in the shape of a *metallic* sublimate, which consists of myriad particles, or, more correctly speaking, globules so minute that they have, without investigation through a microscope, the *appearance* of a white powder or coating, or pyroxide, which, however, when scraped together with the back of a penknife, congeals again into visible balls of mercury; this, therefore, may be cited as a good illustration of a volatile *metal*. Arsenic or antimony, on the other hand, do not volatilise *metallically* on being heated, but in the shape of oxides (arsenious and antimonious acids). You may say "What is the use of telling us such well-known facts?" and if so, I reply—"In order to carefully distinguish between *metallic volatilisation* and *pyroxidation*."

Now, I maintain that English chemists have never (in print) noticed the fact of the *pyroxidation* of silver before the blowpipe, and that the German chemists, especially Plattner, have. In fact, I have cited as proof of the first assertion in my article on silver, the remark of Professor Bloxam, that "silver is not capable of undergoing oxidation in the air *under any circumstances*," and of Dr. Percy's letter to me in 1874, that "I do not believe in the silver oxide which you mention, nor in certain experiments of Plattner, in which he supposed he had proved the existence of volatile oxide of silver."

In spite of the formidable authority of the latter gentleman, and of the decided tone in which his opinion is expressed, I submit that if we fuse, before a pyrogene or blowpipe, the smallest proportion of silver in lead or any silver ore, or, in short, any substance affording under such conditions a sublimate, and containing the minutest trace of silver, there will be a "rose" or bluish violet tinge to that sublimate, or part of it, in proportion to the quantity of silver present, and that, if there be no silver present, we shall have no such tinge. So much is easily observable

even on charcoal; on aluminium plate the reaction is intense. Plattner says (page 402) of the coating on charcoal, "this reddening of the coat is highly characteristic, and may always be regarded as indicating silver."

It will scarcely, I presume, be argued that this "red" substance is volatilised silver, and not a pyroxide, and although it can be proved (as I have shown in my book) that it is not due to silver at all, but to *gold*, it is, as Plattner says, a certain indication of the former metal, which *invariably* affords it under such treatment, having also, as may be readily seen by the operator who uses aluminium as a support, a pyroxide of its own of a golden bronze tint (see page 252 of my work), not so easily recognised in presence of plumbic, &c., sublimate as the pink one. Another question of great importance is raised by the investigation of the former one. Is the green "flame" observed on heating silver before a blowpipe, which affords the two lines "in the green" of the solar spectrum, due to the combustion of volatilised silver or to that of argentic pyroxide? Although such an opinion is contrary to the accepted theories of spectrum analysis, I maintain that it is due to the latter, for if we heat a ball of silver so that the green "flame" impinges upon aluminium plate behind it, we find, at the exact point of contact, the golden bronze coating above mentioned, a little of which scraped off and gently heated in boric or phosphoric acid, gives the reactions of *oxide* of silver, but no trace of the *metal*.—I am, &c.,

W. A. Ross.

London, August, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 3, July 19, 1875.

Distinction between Natural and Artificial Organic Products.—M. L. Pasteur.—The author maintains, in opposition to M. Schützenberger, that all the artificial products of the laboratory have a superposable image, whilst most natural organic products are dissymmetrical, and in consequence of this dissymmetry their image cannot be superposed upon themselves, and that not a single optically inactive body has been rendered active by the reactions of the laboratory.

Note on Magnetism: Reply to an Observation of M. Jamin.—J. M. Gauguain.—In his paper of June 3rd M. Jamin states that he has selected for certain researches the method proposed in 1849 by Van Rees, and adds—"This method has been adopted without modification by M. Gauguain, who admits the principle without having demonstrated it any more than had been done by Van Rees." To this M. Gauguain answers that he has not precisely adopted, but rather re-discovered the method in question.

Oxuvitic Acid, and the Cresol Derived from it.—MM. Oppenheim and S. Pfaff.—Oxuvitic acid results from the action of chloroform upon sodic acetic ether. The same acid is formed by the action of chloral, trichloroacetic ether, and tetrachloride of carbon upon the same ether. On distilling with an excess of lime, and in small portions, 800 grms. oxuvitate of baryta, and 360 grms. oxuvitate of lime, the authors obtained more than 150 grms. of pure cresol. This is meta-cresol.

Compound of Methylic Oxide and Hydrochloric Acid.—M. C. Friedel.—On passing into a receiver, imbedded in a freezing mixture, a mixture of methyl oxide and of hydrochloric acid, pure and dry, there is condensed a colourless mobile liquid, which fumes on exposure to the air, and distils over between -3° and -1° . It is a body analogous to the known compounds of ether with metallic

lorides, and to those of ethyl-oxide and bromine, discovered some time ago by M. Schützenberger.

Diethylic Ether of Xantho-Acetic Acid.—M. C. O. Cech and A. Steiner.—This compound, resulting from the action of ethyl-mono-chlor-acetate upon potassium xanthate is a yellowish oily liquid, heavier than water, and of a disagreeable odour. When distilled under ordinary atmospheric pressure it is decomposed, but it may be distilled in a vacuum. Its composition is $C_7H_{12}O_3S_2$.

Determination of Sulphide of Carbon in the Sulpho-Carbonates of Potash and Soda.—MM. David and Rommier.—Not adapted for abstraction.

No. 4, July 26, 1875.

Distribution of Magnetism in Bundles Composed of Very Thin Plates of a Finite Length.—M. J. Jamin.—This paper consists chiefly of tables and mathematical formulæ, and cannot be usefully abstracted.

Complementary Notice on the Contemporaneous Formation of Minerals by the Thermal Springs of Bourbonne-les-Bains (Haute Marne); Production of Phosgenite.—M. Daubrée.—Phosgenite, which has been met with in large crystals at Crawford, near Matlock in Derbyshire(?), in Scotland, Upper Silesia, and in Sardinia, is a rare species. Here it is produced in abundance. It is coated over with a thin layer of galena, resulting from its decomposition under the combined reducing action of organic matter and of gypsum.

Researches on the Phenomena Produced by Electric Currents of High Potential, and on their Analogies with Natural Phenomena.—M. G. Planté.—Having employed as voltameter a U-tube full of salt water, and submitted it to the action of the electric source indicated in a former communication, the author observed the following phenomena. If, the negative wire being plunged in one of the limbs of the tube, the end of the positive wire is placed in contact with the glass in the other limb, a little above the liquid, we perceive at first around the wire a glittering crown produced by the saline particles which line the tube. If the wire is approached towards the liquid a depression is produced; a luminous arch, bordered with radiating striæ, appears along the glass, and is transformed into an irregular demi-crown with sinuous outline, and animated with a rapid undulatory movement. Steam escapes in rapid jets above the sparks of fire, as if it issued from a boiler under pressure. The concavity of the luminous arch in the voltameter, turned towards the point whence the positive current issues, compared to the concavity of the aurora turned towards the earth, shows that the flow of the electric currents, brought from the equator by the higher winds is from below upwards, that is, from these regions of the atmosphere to still loftier ones. These currents, impinging upon the icy clouds of the poles, which correspond to the saline particles and to the moist glass of the voltameter, are transformed into heat and light, and vapourise the polar clouds which are re-precipitated in the form of snow or rain. Thus the polar aurora is due, not to discharges between the electricity of the atmosphere and that of the ground—which would involve the poles in a perpetual thunderstorm—but rather to the dissemination in the higher atmosphere of the great masses of electricity derived from the surface of the globe in a calorific and luminous form. Finally, if it is permissible to carry out the analogies further, we find in the phenomena observed a reproduction on an infinitely small scale of the possible mode of formation of the heavenly bodies, spherical or annular, and a rapid image of their development down to their extinction or transformation in space. We are thus led to think that in the first impulse given, or in the number of the various movements impressed upon the ethereal matter in the work of creation, it is necessary to include that particular mode of motion which constitutes electricity, masked as it might be under the more striking phenomena of heat and light.

Action of Electrolytic Oxygen upon Glycerin.—M. A. Renard.—Glycerin, mixed with two-thirds its volume of water, acidulated with a twentieth of sulphuric acid, and submitted to the action of electrolytic oxygen, yielded various oxidation products, among which formic and acetic acids have been detected in great quantity; glyceric acid; the first glyceric aldehyd: and a product which may be the acid corresponding to the second glyceric aldehyd.

Pyrites Used in France in the Manufacture of Sulphuric Acid.—MM. A. Girard and H. Morin.—The consumption of pyrites in France has risen during the last ten years from an annual amount of 90,000 tons to 180,000 tons. In England, during the same period, it has risen from 180,000 to 520,000. The pyrites of the Rhone, or of Saint Bel, contain on an average 46 to 48 per cent of sulphur, with 10 to 12 per cent of a gangue of clay, sand, and heavy spar. In the southern portion of the Saint Bel district the sulphur ranges from 50 to 53 per cent. The gangue is slight, and free from baryta. Arsenic is found only in proportions too small to be determined. In the Saint Julien district (le Gard) the pyrites are found not in argillaceous schists, as at Saint Bel, but in the lias or trias. The sulphur varies from 40 to 45 per cent. The gangue is calcareous, and ranges from 3 to 6 per cent. Arsenic is found to the extent of one-tenth per cent, and the amount of calcium fluoride is sometimes determinable. The pyrites of Ardèche contain 45 to 50 per cent of sulphur; the gangue is argillaceous, free from lime. In some samples the arsenic reaches three-tenths per cent. The total amount of pyrites in France is equal to a century's consumption.

Toxic Properties of Alcohols.—The poisonous properties of the fermentation alcohols follow their atomic composition in mathematical order. The higher the figures representing the latter the more deadly is their action, whether injected under the skin or introduced into the stomach.

Thermic Phenomenon which Accompanies "Inversion."—M. G. Fleury.—The author concludes that the inversion of sugar is an exothermic phenomenon, and results necessarily whenever an acid of sufficient power is present.

Substance Used to Adulterate Guano.—M. F. Jean.—For some years there have arrived at Dunkirk large quantities of a pulverulent matter, of a yellowish brown colour, the sole consumption of which is in the sophistication of guano. The amount landed at Dunkirk is more than a million kilos. yearly. The article is especially made in England on the large scale. In colour and specific gravity it agrees closely with genuine guano. It is inodorous, neutral, tasteless, leaves a white ash on ignition, and may be mixed with guano in a considerable proportion without modifying its appearance. It consists of—

| | | |
|--|---------|-------|
| Moisture | .. .. . | 16.80 |
| Sulphate of lime | .. .. . | 63.50 |
| Phosphate of lime, with traces of ferric oxide and alumina | .. .. . | 22.06 |
| Silica | .. .. . | 0.50 |
| Carbonate of lime | .. .. . | 1.60 |
| Chloride of sodium | .. .. . | 3.71 |
| Nitrogenous matter (containing 0.3 per cent of nitrogen) | .. .. . | 1.80 |

99.97

The nitrogenous matter which gives the colour of guano to this mixture is probably obtained by submitting woollen rags to steam at a high pressure.

Moniteur Scientifique, du Dr. Quesneville,
August, 1875.

Observations on Sea-Salts.—Dr. Roux.—A very lengthy treatise on the salts obtained by evaporating seawater. It is quite incapable of useful abstraction.

Antiseptic Properties of Salicylic and Phenic Acids.
—Julius Müller.—Salicylic acid energetically prevents fermentation and putrefaction, and neutralises the effects of inorganic ferments much more strongly than even phenol. This may be explained by the circumstance that salicylic acid acts as much by its acidity as by its anti-fermentescible attributes. Phenol has no acid reaction.

Preparation of Very Concentrated Formic Acid.
—M. Lorin.—Already noticed.

Manufacture of Beer.—Aime Girard.—Not suitable for abstraction.

Procedures for the Cure of the Vine.—M. M. Morel.—A summary of the various methods proposed for the destruction of the phylloxera.

Limited Oxidation of the Carbides of Hydrogen.
—M. Berthelot.—Taken from the *Bulletin de la Société Chimique de Paris*, xxiii., p. 197.

Use of Arsenic in the Production of Aniline Colours.—The firm of Meister, Lucius, and Brünig write to state that since the end of 1872 no arsenic has been employed in their establishment, and that they guarantee all their dyes to be free from that dangerous substance.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent B.Sc. and Preliminary Scientific Examinations:—*First B.Sc. Examination.* (First Division). F. Baylis, Epsom College; J. H. Best, University College; R. Bredin, Liverpool Royal Infirmary School of Medicine and private study; H. A. G. Brooke, B.A., Owens College; G. Brown, Owens College; R. H. Bulley, Owens College; J. E. Clark, B.A., Heidelberg University; C. Dalgarno, private study; A. C. Dixon, private study; J. V. Elsdon, private study; J. W. Evans, University College; G. C. Frames, Royal School of Mines; G. A. Freeman, St. John's College, Battersea, and private study; F. J. Gladman, B.A., private study; C. R. Harrison, University College; H. Heap, St. Mark's College, Chelsea, and private study; W. Hewitt, Royal School of Mines; G. B. Hughes, Wesleyan College, Taunton; T. S. Humpidge, Royal School of Mines; A. H. Jackson, Owens College; W. W. Jones, Magdalen College, Oxford; A. P. Ledward, Owens College; A. H. S. Lucas, New Kingswood School; A. McAlpine, Royal College of Science, Dublin; J. L. McKenzie, private study; J. Mortimer, B.A., University College, London, and University College, Edinburgh; W. J. Noble, Keble College, Oxford; J. O. Park, private study; L. C. Parkes, University College; W. Pearce, St. Mary's Hospital; J. J. Quelch, New College, Eastbourne; D. Robertson, LL.B., private study; D. Ross, B.A., private study; R. H. S. Spicer, private study; W. J. Spratling, private study and Royal School of Chemistry; E. H. Sugden, B.A., Owens and Headingley Colleges; S. P. Thompson, B.A., private study; A. E. Tovey, private study; G. W. von Tunzelmann, University College; E. H. Wainwright, University College; R. Whitby, B.A., private study; A. R. Willis, Royal School of Mines. (Second Division). D. E. Anderson, B.A., Royal College, Mauritius, and University College; G. H. Bailey, private study; J. Enright, private study; W. Fawcett, private study; J. A. Miller, B.A., private study; W. Outhwaite, private study; C. J. Procter, Owens College; J. Spencer, private study; J. H. Stewart, Royal College of Science and private study; W. C. Trafford, University College. *Preliminary Scientific (M.B.) Examination.* (First Division). F. R. Barker, St. Thomas's Hospital; F. Baylis, Epsom College; J. H. Best, University College; R. Bredin, Royal Infirmary School, Liverpool, and private study; H. A. G. Brooke, B.A., Owens College; G. Brown, Owens College; L. A. Cantin, St. Bartholomew's Hospital; W. G. Chuckerbutty, University College; C.

A. D. Clark, St. Bartholomew's Hospital; T. F. Clarke, King's College; W. W. Colborne, University College; M. P. M. Collier, St. Thomas's Hospital; T. Crisp, St. Thomas's Hospital; E. M. Cuffe, Epsom College; C. W. Cunningham, private study; D. S. Davies, St. Thomas's Hospital; A. Dismorr, St. Bartholomew's Hospital; A. C. Dixon, private study; W. W. Edwardes, St. Mary's Hospital; J. V. Elsdon, private study; J. T. Faulkner, Manchester Medical School; H. A. H. Fenton, University College; T. W. Fuller, Guy's Hospital; A. W. Graham, St. Bartholomew's Hospital; M. Greenwood, London Hospital; A. J. Harries, University College; C. R. Harrison, University College; A. Harvey, Queen's College, Birmingham; T. H. Hayle, Owens College; G. A. Herschell, St. Thomas's Hospital; W. Hewitt, Royal School of Mines; J. E. Hine, University College; W. B. Hinton, Guy's Hospital; J. Hodgson, Owens College Medical School; V. A. H. Horsley, University College; T. Hoskin, University College; R. Hughes, private study; T. S. Humpidge, Royal School of Mines; W. W. Jones, Magdalen College, Oxford; A. P. Ledward, Owens College; M. Lichtenstein, private study; W. M. Lory, University College; A. McAlpine, Royal College of Science, Dublin; G. M. McDonald, King's College; A. Meeson, Royal Infirmary, Liverpool; H. J. Michael, St. Thomas's Hospital; F. W. Mott, University College; H. M. Murray, Camden Schools, Brighton, and Sussex College Hospital; J. H. Nankivell, King's College; W. H. Neale, private study; W. J. Noble, Keble College, Oxford; W. J. C. Nourse, St. Mary's Hospital; A. M. Palmer, University College; W. Pasteur, University College; W. Pearce, St. Mary's Hospital; E. Penny, Guy's Hospital; L. C. Ponsford, University College; T. W. O. Pughe, Royal Infirmary, Liverpool; J. J. Quelch, New College, Eastbourne; N. K. Ráy, University of Edinburgh; F. Robinson, Leeds School of Medicine; D. Ross, B.A., private study; F. Rushworth, St. Bartholomew's Hospital; G. H. Russell, Guy's Hospital; T. D. Savill, St. Thomas's Hospital; P. E. Shearman, University College; T. S. Sheldon, Guy's Hospital; J. F. W. Silk, King's College; E. S. Smith, University College; R. P. Smith, St. Thomas's Hospital; J. E. Squire, University College; C. W. Suckling, private study; A. M. Turner, Guy's Hospital; E. H. Wainwright, University College; W. H. White, Guy's Hospital; A. R. Willis, Royal School of Mines; L. C. Wooldridge, Guy's Hospital. (Second Division.) D. G. Allen, St. George's Hospital; W. E. Barton, University College; H. T. Bassett, Queen's College, Birmingham; A. Chillingworth, St. Bartholomew's Hospital; W. L. Cranstone, University College; A. D. Deane, Guy's Hospital; G. J. Eady, private study; J. Enright, private study; T. Finlay, University College; R. Hagyard, Leeds School of Medicine; J. D. Hayward, University, Bonn, and private study; H. Hine, Guy's Hospital; C. P. Hooker, St. Bartholomew's Hospital; G. Hurst, B.A., Sydney, University of Edinburgh; C. M. H. Jones, St. Mary's Hospital; P. S. Kendall, University College; A. Money, University College; E. Nettleford, University College; W. Outhwaite, private study; E. M. Price, University College; A. C. Rich, Royal Infirmary, Liverpool; A. J. McC. Routh, University College; E. F. Smith, St. George's Hospital; H. Swale, University College; R. D. R. Sweeting, London Hospital; G. F. Symons, Guy's Hospital; E. S. Taite, St. Bartholomew's Hospital; W. D. Thomas, Epsom College; W. P. R. Williams, St. George's Hospital; H. W. Yate; Epsom College.

NOTES AND QUERIES.

Gas-Water.—Would any reader oblige by particulars how to test the ammonia in ounce's strength, and state where I can buy the necessary apparatus for same?—CARBON.

Crude Carbonate of Ammonia.—Can any of the readers of the CHEMICAL NEWS inform me if crude carbonate of ammonia containing 26 per cent of NH_3 is readily saleable in large quantity, and if so, what is it used for and how much is it worth per ton?—W.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 822.

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE.

BRISTOL MEETING, AUGUST 25, 1875.

INAUGURAL ADDRESS OF THE PRESIDENT,
Sir JOHN HAWKSHAW, F.R.S.

GENTLEMEN,—To those on whom the British Association confers the honour of presiding over its meetings, the choice of a subject presents some difficulty.

The Presidents of Sections, at each annual meeting, give an account of what is new in their respective departments; and essays on science in general, though desirable and interesting in the earlier years of the Association, would be less appropriate to-day.

Past Presidents have already discoursed on many subjects, on things organic and inorganic, on the mind and on things perhaps beyond the reach of mind; and I have arrived at the conclusion that humbler themes will not be out of place on this occasion.

I propose in this Address to say something of a profession to which my lifetime has been devoted—a theme which cannot perhaps be expected to stand as high in your estimation as in my own, and I may have some difficulty in making it interesting; but I have chosen it because it is a subject I ought to understand better than any other. I propose to say something on its origin, its work, and kindred topics.

Rapid as has been the growth of knowledge and skill as applied to the art of the engineer during the last century, we must, if we would trace its origin, seek far back among the earliest evidences of civilisation.

In early times, when settled communities were few and isolated, the opportunities for the interchange of knowledge were scanty or wanting altogether. Often the slowly accumulated results of the experience of the wisest heads and the most skilful hands of a community were lost on its downfall. Inventions of one period were lost and found again. Many a patient investigator has puzzled his brain in trying to solve a problem which had yielded to a more fortunate labourer in the same field some centuries before.

The ancient Egyptians had a knowledge of Metallurgy, much of which was lost during the years of decline which followed the golden age of their civilisation. The art of casting bronze over iron was known to the Assyrians, though it has only lately been introduced into modern metallurgy; and patents were granted in 1609 for processes connected with the manufacture of glass, which had been practised centuries before.* An inventor in the reign of Tiberius devised a method of producing flexible glass, but the manufactory of the artist was totally destroyed, we are told, in order to prevent the manufacture of copper, silver, and gold from becoming depreciated.†

Again and again engineers, as well as others, have made mistakes from not knowing what those had done who have gone before them, and have had the same difficulties to contend with. In the long discussion which took place as to the practicability of making the Suez Canal, an early objection was brought against it that there was a difference of 32½ feet between the level of the Red Sea and that of

the Mediterranean. Laplace at once declared that such could not be the case, for the mean level of the sea was the same on all parts of the globe. Centuries before the time of Laplace the same objection had been raised against a project for joining the waters of these two seas. According to the old Greek and Roman historians, it was a fear of flooding Egypt with the waters of the Red Sea that made Darius, and in later times, again, Ptolemy, hesitate to open the canal between Suez and the Nile.* Yet this canal was made, and was in use some centuries before the time of Darius.

Strabo† tells us that the same objection—that the adjoining seas were of different levels—was made by his engineers to Demetrius,‡ who wished to cut a canal through the Isthmus of Corinth some two thousand years ago. But Strabo|| dismisses at once this idea of a difference of level, agreeing with Archimedes that the force of gravity spreads the sea equally over the earth.

When knowledge in its higher branches was confined to a few, those who possessed it were often called upon to perform many and various services for the communities to which they belonged; and we find mathematicians and astronomers, painters and sculptors, and priests, called upon to perform the duties which now pertain to the profession of the architect and the engineer. And as soon as civilisation had advanced so far as to admit of the accumulation of wealth and power, then kings and rulers sought to add to their glory while living by the erection of magnificent dwelling-places, and to provide for their aggrandisement after death by the construction of costly tombs and temples. Accordingly, we soon find men of ability and learning devoting a great part of their time to building and architecture, and the post of architect became one of honour and profit. In one of the most ancient quarries of Egypt a royal high architect of the dynasty of the Psammetici has left his pedigree sculptured on the rock, extending back for twenty-three generations, all of whom held the same post in succession in connection with considerable sacerdotal offices.§

As there were in these remote times officers whose duty it was to design and construct, so also there were those whose duty it was to maintain and repair the royal palaces and temples. In Assyria, 700 years before our era, as we know from a tablet found in the palace of Sennacherib by Mr. Smith, there was an officer whose title was the Master of Works. The tablet I allude to is inscribed with a petition to the king from an officer in charge of a palace, requesting that the Master of Works may be sent to attend to some repairs which were much needed at the time.¶

Under the Roman Empire there was almost as great a division of labour in connection with building and design as now exists. The great works of that period were executed and maintained by an army of officers and workmen, who had special duties assigned to each of them.

Passing by those early attempts at design and construction which supplied the mere wants of the individual and the household, it is to the East that we must turn if we would find the earliest works which display a knowledge of engineering. Whether the knowledge of engineering, if we may so call it, possessed by the people of Chaldaea and Babylonia was of native growth or was borrowed from Egypt is, perhaps, a question which cannot yet be answered. Both people were agricultural, dwelling on fertile plains, intersected by great rivers, with a soil requiring water only to enable it to bring forth inexhaustible crops. Similar circumstances would create similar wants, and stimulate to action similar faculties to satisfy them. Apart from the question of priority of knowledge, we know that at a very early period—some four or five thousand years

* Layard's "Nineveh and Babylon," p. 191; Beckman's "History of Inventions," vol. ii., p. 85.

† Pliny, "Nat. Hist.," Bk. xxxvi., c. 66;

* Pliny, "Nat. Hist.," Bk. vi., c. 33.

† Strabo, c. iii., § 11.

‡ Demetrius I., King of Macedonia, died 283 B.C.

|| Strabo, c. iii., Sec. 12.

§ "Discoveries in Egypt, Ethiopia, &c.," by Dr. Lepsius, 2nd ed., p. 318.

¶ Smith's (G.) "Assyrian Discoveries," 2nd edit., p. 414.

ago at least—there were men in Mesopotamia and Egypt who possessed considerable mechanical knowledge, and no little skill in hydraulic engineering. Of the men themselves we know little: happily, works often remain when the names of those who conceived and executed them have long been forgotten.

It has been said that architecture had its origin not only in nature, but in religion; and if we regard the earliest works which required mechanical knowledge and skill, the same may be said of engineering. The largest stones were chosen for sacred buildings, that they might be more enduring as well as more imposing, thereby calling for improvement and invention of mechanical contrivances, to assist in transporting and elevating them to the position they were to occupy; for the same reason the hardest and most costly materials were chosen, calling for further improvement in the metal forming the tools required to work them. The working of metals was further perfected in making images of the gods, and in adorning with the more precious and ornamental sorts the interior and even external parts of their shrines.

The earliest buildings of stone to which we can assign a date, with any approach to accuracy, are the pyramids of Gizeli. To their builders they were sacred buildings, even more sacred than their temples or temple palaces. They were built to preserve the royal remains, until, after a lapse of 3000 years, which we have reason to believe was the period assigned, the spirit which had once animated the body should re-enter it.* Although built 5000 years ago, the masonry of the Pyramids could not be surpassed in these days; all those who have seen and examined them, as I myself have done, agree in this: moreover, the design is perfect for the purpose for which they were intended, above all to endure. The building of pyramids in Egypt continued for some ten centuries, and from sixty to seventy still remain, but none are so admirably constructed as those of Gizeli. Still, many contain enormous blocks of granite from 30 to 40 feet long, weighing more than 300 tons, and display the greatest ingenuity in the way in which the sepulchral chambers are constructed and concealed.†

The genius for dealing with large masses in building did not pass away with the pyramid builders in Egypt, but their descendants continued to gain in mechanical knowledge, judging from the enormous blocks which they handled with precision. When the command of human labour was unlimited, the mere transport of such blocks as the statue of Rameses the Great, for instance, which weighed over 800 tons, need not so greatly excite our wonder; and we know how such blocks were moved from place to place, for it is shown on the wall paintings of tombs of the period which still remain.

But as the weight of the mass to be moved is increased, it becomes no longer a question of only providing force in the shape of human bone and muscle. In moving, in the last century, the block which now forms the base for the statue of Peter the Great, at St. Petersburg, and which weighs 1200 tons, force could be applied as much as was wanted, but great difficulty was experienced in supporting it, and the iron balls on which it was proposed to roll the block along were crushed, and a harder metal had to be substituted.‡ To facilitate the transport of material, the Egyptians made solid causeways of granite from the Nile to the Pyramids; and in the opinion of Herodotus, who saw them, the causeways were more wonderful works than the Pyramids themselves.§

The Egyptians have left no record of how they accomplished a far more difficult operation than the mere transport of weight—that is, how they erected obelisks weighing more than 400 tons. Some of these obelisks must have been lifted vertically to place them in position, as they

were by Fontana in Rome in later times, when the knowledge of mechanics, we know, was far advanced.*

The practice of using large blocks of stone, either as monoliths or as forming parts of structures, has existed from the earliest times in all parts of the world.

The Peruvians used blocks weighing from 15 to 20 tons, and fitted them with the greatest nicety in their cleverly designed fortifications.†

In India, large blocks were used in bridges when the repugnance of Indian builders to the use of the arch rendered them necessary, or in temples where—as in the Temple of the Sun at Orissa—stones weighing from 20 to 30 tons form part of the pyramidal roof at a height of from 70 to 80 feet from the ground.‡ Even as late as the last century, Indians, without the aid of machinery, were using blocks of granite above 40 feet long for the doorposts of the gateway of Seringham, and roofing blocks of the same stone for a span of 21 feet.¶

At Persepolis, in the striking remains of the palaces of Xerxes and Darius, more than one traveller has noted the great size of the stones, some of which are stated to be 55 feet long and 6 to 10 feet broad.

So in the Greek temples of Sicily, many of the blocks in the upper parts of the temples are from 10 to 20 tons weight.

The Romans, though they did not commonly use such large stones in their own constructions, carried off the largest obelisks from Egypt and erected them at Rome, where more are now to be found than remain in Egypt. In the temples of Baalbek, erected under Roman rule, perhaps the largest stones are to be found which have been used for building since the time of the Pharaohs. The terrace wall of one of the temples is composed of three courses of stones, none of which are less than 30 feet long; and one stone still lies in the quarry squared and ready for transport, which is 70 feet long and 14 feet square, and weighs upwards of 1135 tons, or nearly as much as one of the tubes of the Britannia Bridge.

I have not mentioned dolmens and menhirs, rude unhewn stones often weighing from 30 to 40 tons, which are found from Ireland to India, and from Scandinavia to the Atlas, in Africa. To transport and erect such rude masses required little mechanical knowledge or skill, and the operation has excited more wonder than it deserves. Moreover, Fergusson has gone far to show that the date assigned to many of them hitherto has been far too remote; most, and possibly all, of those in northern and western Europe having been erected since the time of the Roman occupation. And to this day the same author shows that menhirs, single stones often weighing over 20 tons, are erected by hill tribes of India in close proximity to stone buildings of elaborate design and finished execution, erected by another race of men.§

For whatever purpose these vast stones were selected—whether to enhance the value or to prolong the endurance of the buildings of which they formed a part—the tax on the ingenuity of those who moved and placed them must have tended to advance the knowledge of mechanical appliances.

The ancient Assyrians and Egyptians had possibly more knowledge of mechanical appliances than they are generally credited with. In the wall paintings and sculptures which show their mode of transporting large blocks of stone, the lever is the only mechanical power represented, and which they appear to have used in such operations; nor ought we to expect to find any other used, for, where the supply of human labour was unlimited, the most expeditious mode of dragging a heavy weight along would

* For obelisk erected at Arles, 1676, see Rondelet's "L'Art de Bâtir," vol. i., p. 48. Its weight was nearly 200 tons, and it was suspended vertically by eight ships' masts.

† Fergusson's "History of Architecture," vol. ii., p. 779; Squier, "Peru," p. 24.

‡ The Temple of the Sun was built 1237—1282 A.D.—Hunter's "Orissa," vol. i., pp. 288, 297.

¶ Fergusson's "Rude Stone Monuments," p. 96.

§ Fergusson's "Rude Stone Monuments," pp. 461—465.

* Fergusson's "History of Architecture," vol. i., p. 83; Wilkinson's "Ancient Egyptians," 2nd series, vol. ii., p. 444.

† Vyse's "Pyramids of Gizeh," vol. iii., pp. 16, 41, 45, 57.

‡ Rondelet's "Traité de l'Art de Bâtir," vol. i., p. 73.

§ Herodotus, Bk. ii. c. 124.

be by human power; to have applied pulleys and capstans, such as would now be employed in similar undertakings, would have been mere waste of time. In some countries, even now, where manual labour is more plentiful than mechanical appliances, large numbers of men are employed to transport heavy weights, and do the work in less time than it could be done with all our modern mechanical appliances. In other operations, such as raising obelisks, or the large stones used in their temple palaces, where human labour could not be applied to such advantage, it is quite possible that the Egyptians used mechanical aids. On one of the carved slabs which formed part of the wall panelling of the palace of Sardanapalus, which was built about 930 years before our era, a single pulley is clearly shown, by which a man is in the act of raising a bucket—probably drawing water from a well.*

It has sometimes been questioned whether the Egyptians had a knowledge of steel. It seems unreasonable to deny them this knowledge. Iron was known at the earliest times of which we have any record. It is often mentioned in the Bible, and in Homer; it is shown in the early paintings on the walls of the tombs at Thebes, where butchers are represented as sharpening their knives on pieces of metal coloured blue, which were most probably pieces of steel.† Iron has been found in quantity in the ruined palaces of Assyria; and in the inscriptions of that country fetters are spoken of as having been made of iron, which is also so mentioned in connection with other metals as to lead to the supposition that it was regarded as a base and common metal. Moreover, in the Great Pyramid a piece of iron was found in a place where it must have lain for 5000 years.‡ The tendency of iron to oxidise must render its preservation for any long period rare and exceptional. The quality of iron which is now made by the native races of Africa and India is that which is known as wrought iron: in ancient times, Dr. Percy says the iron which was made was always wrought iron. It is very nearly pure iron, and a very small addition of carbon would convert it into steel. Dr. Percy says the extraction of good malleable iron directly from the ore "requires a degree of skill very far inferior to that which is implied in the manufacture of bronze."|| And there is no great secret in making steel: the natives of India now make excellent steel in the most primitive way, which they have practised from time immemorial. When steel is to be made, the proportion of charcoal used with a given quantity of ore is somewhat larger, and the blast is applied more slowly than when wrought iron is the metal required.§ Thus, a vigorous native working the bellows of skin would make wrought iron where a lazy one would have made steel. The only apparatus required for the manufacture of the finest steel from iron ore is some clay for making a small furnace 4 feet high, and from 1 to 2 feet broad, some charcoal for fuel, and a skin with a bamboo tuyere for creating the blast.

The supply of iron in India as early as the fourth and fifth centuries seems to have been unlimited. The iron pillar of Delhi is a remarkable work for such an early period. It is a single piece of wrought iron 50 ft. in length, and it weighs not less than 17 tons.¶ How the Indians forged this large mass of iron and other heavy pieces which their distrust of the arch led them to use in the construction of roofs, we do not know. In the temples of Orissa iron was used in large masses as beams or girders in roof-work in the thirteenth century.**

The influence of the discovery of iron on the progress of art and science cannot be over-estimated. India well repaid any advantage which she may have derived from

the early civilised communities of the West if she were the first to supply them with iron and steel.

An interesting social problem is afforded by a comparison of the relative conditions of India and this country at the present time. India, from thirty to forty centuries ago, was skilled in the manufacture of iron and cotton goods, which manufactures, in less than a century, have done so much for this country. It is true that in India coal is not so abundant or so universally distributed as in this country. Yet, if we look still further to the East, China had probably knowledge of the use of metals as soon as India, and moreover had a boundless store of iron and coal. Baron Richthofen, who has visited and described some of the coalfields of China, believes that one province alone, that of Southern Shansi, could supply the world at its present rate of consumption for several thousand years. The coal is near the surface, and iron abounds with it. Marco Polo tells us that coal was universally used as fuel in the parts of China which he visited towards the end of the fourteenth century, and from other sources we have reason to believe it was used there as fuel 2000 years ago. But what progress has China made in the last ten centuries? A great future is undoubtedly in store for that country; but can the race who now dwell there develop its resources, or must they await the aid of an Aryan race? Or is anything more necessary than a change of institutions, which might come unexpectedly, as in Japan?

The art of extracting metals from the ore was practised at a very early date in this country. The existence long ago of tin mines in Cornwall, which are so often spoken of by classical writers, is well known to all. That iron was also extracted from the ore by the ancient Britons is most probable, as it was largely used for many purposes by them before the Roman conquest. The Romans worked iron extensively in the Weald of Kent, as we assume from the large heaps of slag containing Roman coins which still remain there. The Romans always availed themselves of the mineral wealth of the countries which they conquered, and their mining operations were often carried out on the largest scale, as in Spain, for instance, where as many as forty thousand miners were regularly employed in the mines at New Carthage.*

Coal, which was used for ordinary purposes in England as early as the ninth century, does not appear to have been largely used for iron smelting until the eighteenth century, though a patent was granted for smelting iron with coal in the year 1611.† The use of charcoal for that purpose was not given up until the beginning of this century, since which period an enormous increase in the mining and metallurgical industries has taken place; the quantity of coal raised in the United Kingdom in 1873 having amounted to 127 million tons, and the quantity of pig iron to upwards of 6½ million tons.

The early building energy of the world was chiefly spent on the erection of tombs, temples, and palaces.

While, in Egypt, as we have seen, the art of building in stone had 5000 years ago reached the greatest perfection, so in Mesopotamia the art of building with brick, the only available material in that country, was in an equally advanced state some ten centuries later. That buildings of such a material have lasted to this day shows how well the work was done; their ruinous condition even now is owing to their having served as quarries for the last three or four thousand years, so that the name of Nebuchadnezzar, apparently one of the greatest builders of ancient times, is as common on the bricks of many modern towns in Persia as it was in old times in Babylon. The labour required to construct the brick temples and palaces of Chaldæa and Assyria must have been enormous. The mound of Koyunjik alone contained 14½ million tons, and represents the labour of 10,000 men for twelve years. The palace of Sennacherib, which stood on this mound, was probably the largest ever built by any one monarch,

* Layard's "Nineveh and its Remains," vol. ii., p. 31.

† Wilkinson's "Ancient Egyptians," vol. iii., p. 247.

‡ Vyse's "Pyramids of Gizeh," vol. i., p. 275.

|| Percy's "Iron and Steel," p. 873.

§ *Ibid.*, p. 259.

¶ Fergusson's "History of Architecture," vol. ii., p. 460; and "Rude Stone Monuments," pp. 481-3. Cunningham's "Archæological Survey of India," vol. i., p. 169.

** Hunter's "Orissa," vol. i., p. 298.

* Strabo, Bk. iii., c. ii., sec. 10.

† Percy's "Iron and Steel," p. 882.

containing as it did more than two miles of walls, panelled with sculptured alabaster slabs, and twenty-seven portals, formed by colossal bulls and sphinxes.*

The pyramidal temples of Chaldæa are not less remarkable for the labour bestowed on them, and far surpass the buildings of Assyria in the excellence of their brickwork.

The practice of building great pyramidal temples seems to have passed eastwards to India and Burmah, where it appears in buildings of a later date, in Buddhist topes and pagodas; marvels of skill in masonry, and far surpassing the old brick moulds of Chaldæa in richness of design and in workmanship. Even so late as this century a king of Burmah began to build a brick temple of the old type, the largest building, according to Fergusson, which has been attempted since the Pyramids.†

The mere magnitude of many of these works is not so wonderful when we take into account the abundance of labour which those rulers could command. Countries were depopulated, and their inhabitants carried off and made to labour for the conquerors. The inscriptions of Assyria describe minutely the spoils of war and the number of captives; and in Egypt we have frequent mention made of works being executed by the labour of captive peoples. Herodotus tells us that as many as 360,000 men were employed in building one palace for Sennacherib.‡ At the same time, it must not be forgotten that the very character of the multitude would demand from some one the skill and brain to organise and direct, to design and plan the work.

It would be surprising if men who were capable of undertaking and successfully completing unproductive works of such magnitude did not also employ their powers on works of a more useful class. Traces still remain of such works; enough to show, when compared with the scanty records of the times which have come down to us, that the prosperity of such countries as Egypt and Mesopotamia was not wholly dependent on war and conquest, but that the reverse was more likely the case, and that the natural capabilities of those countries were greatly enlarged by the construction of useful works of such magnitude as to equal, if not in some cases surpass, those of modern times.

Egypt was probably far better irrigated in the days of the Pharaohs than it is now. To those unacquainted with the difficulties which must be met with and overcome before a successful system of irrigation can be carried out, even in countries in which the physical conditions are favourable, it may appear that nothing more is required than an adequate supply of unskilled labour. Far more than this was required: the Egyptians had some knowledge of surveying, for Eustathius says they recorded their marches on maps;|| but such knowledge was probably in those days very limited, and it required no ordinary grasp of mind to see the utility of such extensive works as were carried out in Egypt and Mesopotamia, and, having seen the utility, to successfully design and execute them. To cite one in Egypt—Lake Mœris, of which the remains have been explored by M. Linant, was a reservoir made by one of the Pharaohs, and supplied by the flood waters of the Nile. It was 150 square miles in extent, and was retained by a bank or dam 60 yards wide and 10 high, which can be traced for a distance of thirteen miles. This reservoir was capable of irrigating 1200 square miles of country.§ No work of this class has been undertaken on so vast a scale since, even in these days of great works.

The prosperity of Egypt was in so great a measure dependent on its great river, that we should expect that the Egyptians, a people so advanced in art and science,

would at an early period have made themselves acquainted with its *regimé*. We know that they carefully registered the height of the annual rise of its waters; such registers still remain inscribed on the rocks on the banks of the Nile, with the name of the king in whose reign they were made.* The people of Mesopotamia were equally observant of the *regimé* of their great rivers, and took advantage in designing their canals of the different periods of the rising of the waters of the Tigris and Euphrates. A special officer was appointed in Babylon, whose duty it was to measure the rise of the river; and he is mentioned in an inscription found in the ruins of that city, as recording the height of the water in the temple of Bel.† The Assyrians, who had a far more difficult country to deal with, owing to its rocky and uneven surface, showed even greater skill than the Babylonians in forming their canals, tunnelling through rock, and building dams of masonry across the Euphrates. While the greater number of these canals in Egypt and Mesopotamia were made for the purpose of irrigation, others seem to have been made to serve at the same time for navigation. Such was the canal which effected a junction between the Mediterranean and the Red Sea, which was a remarkable work, having regard to the requirements of the age in which it was made. Its length was about 80 miles; its width admitted of two triremes passing one another.‡ At least one of the navigable canals of Babylonia, attributed to Nebuchadnezzar, can compare in extent with any work of later times. I believe Sir H. Rawlinson has traced the canal to which I allude throughout the greater part of its course, from Hit on the Euphrates to the Persian Gulf, a distance of between four and five hundred miles.|| It is a proof of the estimation in which such works were held in Babylonia and Assyria, that, among the titles of the god Vul were those of "Lord of Canals," and "The Establisher of Irrigation Works."§

The springs of knowledge which had flowed so long in Babylonia and Assyria were dried up at an early period. With the fall of Babylon and destruction of Nineveh the settled population of the fertile plains around them disappeared, and that which was desert before man led the waters over it became desert again, affording a wide field for, and one well worthy of, the labours of engineers to come.

Such was not the case with Egypt. Long after the period of its greatest prosperity was reached, it remained the fountain head from whence knowledge flowed to Greece and Rome. The philosophers of Greece and those who, like Archimedes, were possessed of the best mechanical knowledge of the time, repaired to Egypt to study and obtain the foundation of their knowledge from thence.

Much as Greece and Rome were indebted to Egypt, it will probably be found, as the inscribed tablets met with in the mounds of Assyria and Chaldæa are deciphered, that the later civilisations owe, if not more, at least as much, to those countries as to Egypt. This is the opinion of Mr. Smith, who, in his work describing his recent interesting discoveries in the East, says that the classical nations "borrowed far more from the valley of the Euphrates than that of the Nile."¶

In the science of astronomy, which in these days is making such marvellous discoveries, Chaldæa was undoubtedly pre-eminent. Among the many relics of these ancient peoples which Mr. Smith has recently brought to this country is a portion of a metal astrolabe from the palace of Sennacherib, and a tablet on which is recorded the division of the heavens according to the four seasons, and the rule for regulating the intercalary month of the year. Not only did the Chaldeans map out the heavens

* Layard's "Nineveh and Babylon," p. 589.

† Fergusson's "History of Architecture," vol. ii., p. 523.

‡ Rawlinson's "Herodotus," vol. i., p. 389, second edition.

§ Rawlinson's "Herodotus," vol. ii., p. 278, second edition.

|| M. Linant's "Mémoire sur le lac Mœris."

* Lepsius's "Discoveries in Egypt," &c., p. 268.

† Smith's "Assyrian Discoveries," pp. 395-7, second edition.

‡ "Herodotus," Bk. ii., c. clviii.

|| Rawlinson's "Herodotus," vol. i., p. 420, second edition.

§ *Ibid.*, p. 498.

¶ Smith's (G.) "Assyrian Discoveries," p. 451, second edition.

and arrange the stars, but they traced the motion of the planets, and observed the appearance of comets; they fixed the signs of the zodiac, and they studied the sun and moon and the periods of eclipses.*

But to return to that branch of knowledge to which I wish more particularly to draw your attention, as it grew and spread from East to West, from Asia over Europe. Of all nations of Europe, the Greeks were most intimately connected with the civilisation of the East. A maritime people by the nature of the land they lived in, colonisation followed as a matter of course on the tracks of their trading vessels; and thus, more than any other people, they helped to spread Eastern knowledge along the shores of the Mediterranean, and throughout the South of Europe.

The early constructive works of Greece, till about the seventh century B.C., form a strong contrast to those of its more prosperous days. Commonly called Pelasgian, they are more remarkable as engineering works than admirable as those which followed them were for architectural beauty. Walls of huge unshapely stones—admirably fitted together, however—tunnels, and bridges, characterise this period. In Greece, during the few and glorious centuries which followed, the one aim in all construction was to please the eye, to gratify the sense of beauty; and in no age was that aim more thoroughly and satisfactorily attained.

In these days, when sanitary questions attract each year more attention, we may call to mind that twenty-three centuries ago the city of Agrigentum possessed a system of sewers, which, on account of their large size, were thought worthy of mention by Diodorus.† This is not, however, the first record of towns being drained; the well-known Cloaca Maxima, which formed part of the drainage system of Rome, was built some two centuries earlier, and great vaulted drains passed beneath the palace mounds of unburnt brick at Nimroud and Babylon; and possibly we owe the preservation of many of the interesting remains found in the brick mounds of Chaldæa to the very elaborate system of pipe drainage discovered in them, and described by Loftus.‡

Whilst Pelasgian art was being superseded in Greece, the city of Rome was founded in the eighth century before our era; and Etruscan art in Italy, like the Pelasgian art in Greece, was slowly merged in that of an Aryan race. The Etruscans, like the Pelasgians and the old Egyptians, were Turanians, and remarkable for their purely constructive or engineering works. Their city walls far surpass those of any other ancient race, and their drainage works and tunnels are most remarkable.

The only age which can compare with the present one in the rapid extension of utilitarian works over the face of the civilised world, is that during which the Romans, an Aryan race, as we are, were in power. As Fergusson has said, the mission of the Aryan races appears to be to pervade the world with useful and industrial arts. That the Romans adorned their bridges, their aqueducts, and their roads; that with a sound knowledge of construction they frequently made it subservient to decoration, was partly owing to the mixture of Etruscan or Turanian blood in their veins, and partly to their great wealth, which made them disregard cost in their construction, and to their love of display.

It would be impossible for me to do justice to even a small part of the engineering works which have survived fourteen centuries of strife, and remain to this day as monuments of the skill, the energy, and ability of the great Roman people. Fortunately, their works are more accessible than those of which I have spoken hitherto, and many of you are probably already familiar with them.

Conquerors of the greater part of the civilised world, the

admirable organisation of the Romans enabled them to make good use of the unbounded resources which were at their disposal. Yet, while the capital was enriched, the development of the resources of the most distant provinces of the empire was never neglected.

War, with all its attendant evils, has often indirectly benefitted mankind. In the long sieges which took place during the old wars of Greece and Rome, the inventive power of man was taxed to the utmost to provide machines for attack and defence. The ablest mathematicians and philosophers were pressed into the service, and helped to turn the scale in favour of their employers. The world has to regret the loss of more than one, who, like Archimedes, fell slain by the soldiery while applying the best scientific knowledge of the day to devising means of defence during the siege.* In these days, too, science owes much to the labours of engineers and able men, whose time is spent in making and improving guns, the materials composing them, and armour plates to resist them, or in studying the motion of ships of war in a seaway.

The necessity for roads and bridges for military purposes has led to their being made where the necessary stimulus from other causes was wanting; and so means of communication, and the interchange of commodities, so essential to the prosperity of any community, have thus been provided. Such was the case under the Roman Empire. So, too, in later times, the ambition of Napoleon covered France and the countries subject to her with an admirable system of military roads. At the same time, we must do Napoleon the justice of saying that his genius and foresight gave a great impetus to the construction of all works favourable to commercial progress. So, again, in this country, it was the rebellion of 1745, and the want felt of roads for military purposes, which first led to the construction of a system of roads in it unequalled since the time of the Roman occupation. And lastly, in India, in Germany, and in Russia, more than one example could be pointed out where industry will benefit by railways which have originated in military precautions rather than in commercial requirements.

But to return to Rome. Roads followed the tracks of her legions into the most distant provinces of the empire. Three hundred and seventy-two great roads are enumerated, together more than 48,000 miles in length, according to the itinerary of Antoninus.

The water supply of Rome during the first century of our era would suffice for a population of seven millions, supplied at the rate at which the present population of London is supplied. This water was conveyed to Rome by nine aqueducts; and in later years the supply was increased by the construction of five more aqueducts. Three of the old aqueducts have sufficed to supply the wants of the city in modern times. These aqueducts of Rome are to be numbered among her grandest engineering works.† Time will not admit of my saying anything about her harbour works and bridges, her basilicas and baths, and numerous other works in Europe, in Asia, and in Africa. Not only were these works executed in a substantial and perfect manner, but they were maintained by an efficient staff of men divided into bodies, each having their special duties to perform. The highest officers of state superintended the construction of works, were proud to have their names associated with them, and constructed extensive works at their own expense.

Progress in Europe stopped with the fall of the Roman Empire. In the fourth and succeeding centuries the barbarian hordes of Western Asia, people who felt no want of roads and bridges, swept over Europe to plunder and destroy.

With the seventh century began the rise of the Mohammedan power, and a partial return to conditions apparently more favourable to the progress of industrial

* *Ibid.*

† Agrigentum was a celebrated Greek city, founded B.C. 582, population 200,000 (Diodorus, 406 B.C.), drained by Phœax, who lived B.C. 480.

‡ Rawlinson's "Five Ancient Monarchies," vol. i., pp. 89, 90, second edition.

* Archimedes, B.C. 287-212; killed at the siege of Syracuse by the Roman soldiers.

† Total length 250 miles; 50 on arches, 200 underground.

art, when widespread lands were again united under the sway of powerful rulers.* Science owes much to Arab scholars, who kept and handed on to us the knowledge acquired so slowly in ancient times, and much of which would have been lost but for them. Still, few useful works remain to mark the supremacy of the Mohammedan power at all comparable to those of the age which preceded its rise.

A great building age began in Europe in the tenth century, and lasted through the thirteenth. It was during this period that these great ecclesiastical buildings were erected, which are not more remarkable for artistic excellence than for boldness in design.

While the building of cathedrals progressed on all sides in Europe, works of a utilitarian character, which concern the engineer, did not receive such encouragement, excepting perhaps in Italy:

From the twelfth to the thirteenth centuries, with the revival of the arts and sciences in the Italian republics, many important works were undertaken for the improvement of the rivers and harbours of Italy. In 1481 canal locks were first used; and some of the earliest of which we have record were erected by Leonardo da Vinci, who would be remembered as a skilful engineer had he not left other greater and more attractive works to claim the homage of posterity.

The great use that has since been made of this simple means of transferring floating vessels from one water level to another, in connection not only with inland navigation, but in all the great ports and harbours of the world, renders it all the more deserving of remark.

In India, under the Moguls, irrigation works, for which they had a natural aptitude, were carried on during these centuries with vigour, and more than one emperor is noted for the numerous great works of this nature which he carried out. If the native records can be trusted, the number of hydraulic works undertaken by some rulers is surprising. Tradition relates that one king, who reigned in Orissa in the twelfth century, made one million tanks or reservoirs, besides building sixty temples, and erecting numerous other works.†

In India, the frequent overflow of the great rivers, and the periodical droughts, which rendered irrigation necessary, led to extensive protective works being undertaken at an early period; but as these works have been maintained by successive rulers, Mogul and Mohammedan, until recent times, and have not been left for our inspection, deserted and useless for 3000 years or more, as is often the case in Egypt and Mesopotamia, there is more difficulty in ascertaining the date of such works in India.

Works of irrigation were among the earliest attempts at engineering undertaken by the least civilised inhabitants in all parts of the world. Even in Australia, where savages are found as low as any in the scale of civilisation, traces of irrigation works have been found. These works, however, must be taken to show that the natives were once somewhat more civilised than we now find them. In Feejee, our new possession, the natives occasionally irrigate their land,‡ and have executed a work of a higher class, a canal some two miles long and sixty feet wide, to shorten the distance passed over by their canoes.¶ The natives of New Caledonia irrigate their fields with great skill.§ In Peru, the Incas excelled in irrigation as in other great and useful works, and constructed most admirable underground conduits of masonry for the purpose of increasing the fertility of the land.¶¶

It is frequently easier to lead water where it is wanted

* "Under the last of the house of Ommiyah (750 A.D.) one command was obeyed almost along the whole diameter of the known world, from the banks of the Sihon to the utmost promontory of Portugal."—Hallam's "Middle Ages," vol. ii., p. 120, 2nd edition.

† King Bhim Deo, A.D. 1174, 60 temples, 10 bridges, 40 wells stone cased, 152 landing stairs, and one million tanks.—Hunter's "Orissa," vol. i., p. 100.

‡ Erskine's "Western Pacific," p. 171.

¶ Seeman, p. 82.

§ Erskine's "Western Pacific," p. 355.

¶ Markham's "Cieza" (note

than to check its irruption into places where its presence is an evil, often a disaster. For centuries the existence of a large part of Holland has been dependent on the skill of man. How soon he began in that country to contest with the sea the possession of the land we do not know, but early in the twelfth century dykes were constructed to keep back the ocean. As the prosperity of the country increased with the great extension of its commerce, and land became more valuable and necessary for an increasing population, very extensive works were undertaken. Land was reclaimed from the sea, canals were cut, and machines were designed for lifting water. To the practical knowledge acquired by the Dutch, whose method of carrying out hydraulic works is original and of native growth, much of the knowledge of the present day in embanking, and draining, and canal making is due. The North Holland Canal* was the largest navigable canal in existence until the Suez Canal was completed; and the Dutch have just now nearly finished making a sea canal from Amsterdam to the North Sea, which, though not equal to the Suez Canal in length, will be as great in width and depth, and involves perhaps larger and more important works of art. This country was for many years beholden to the Dutch for help in carrying out hydraulic works. In the seventeenth century much fen land in the Eastern Counties was drained by Dutch labour, directed by Dutch engineers, among whom Sir Cornelius Vermuyden, an old campaigner of the 'Thirty Years' War, and a colonel of horse under Cromwell, is the most noted.

While the Dutch were acquiring practical knowledge in dealing with water, and we in Britain, among others, were benefiting by their experience, the disastrous results which ensued from the inundations caused by the Italian rivers of the Alps gave a new importance to the science of hydraulics. Some of the greatest philosophers of the seventeenth century—among them Torricelli, a pupil of Galileo†—were called upon to advise and to superintend engineering works. Nor did they confine themselves to the construction of preventive works, but thoroughly investigated the condition pertaining to fluids at rest or in motion, and gave to the world a valuable series of work on hydraulics and hydraulic engineering, which form the basis of our knowledge of these subjects at the present day.

Some of the best scientific works (prior to the nineteenth century) on engineering subjects we owe to Italian and French writers. The writings of Belidor, an officer of artillery in France in the seventeenth century, who did not, however, confine himself to military subjects, drew attention to engineering questions. Not long after their appearance the Ponts et Chaussées‡ were established, which has maintained ever since a body of able men specially educated for, and devoted to, the prosecution of industrial works.

The impulse given to road-making in the early part of the last century soon extended to canals and means for facilitating locomotion and transport generally. Tramways were used in connection with mines at least as early as the middle of the seventeenth century, but the rails were, in those days, of wood. The first iron rails are said to have been laid in this country as early as 1738; after which time their use was gradually extended, until it became general in mining districts.

By the beginning of this century the great ports of England were connected by a system of canals; and new harbour works became necessary, and were provided, to accommodate the increase of commerce and trade, which improved means of internal transport had rendered possible. It was in the construction of these works that our own Brindley and Smeaton, Telford and Rennie, and other engineers of their time, did so much.

But it was not until the steam-engine, improved and almost created by the illustrious Watt, became such a

* North Holland Canal, finished in 1825.

† Galileo, b. 1564; Torricelli, b. 1608.

‡ Ponts et Chaussées, established 1720.

potent instrument, that engineering works to the extent they have since been carried out became possible or necessary. It gave mankind no new faculty, but it at once set his other faculties on an eminence, from which the extent of his future operations became almost unlimited.

Water-mills, wind-mills, and horse-machines were in most cases superseded. Deep mines, before only accessible by adits and water levels, could at once be reached with ease and economy. Lakes and fens which, but for the steam-engine, would have been left untouched, were drained and cultivated.

The slow and laborious toil of hands and fingers, bone and sinew, was turned to other employments, where, aided by ingenious mechanical contrivances, the produce of one pair of hands was multiplied a thousand-fold, and their cunning extended until results marvellous, if you consider them, were attained. Since the time of Watt the steam-engine has exerted a power, made conquests, and increased and multiplied the material interests of this globe to an extent which it is scarcely possible to realise.

But while Watt has gained a world-wide, well-earned fame, the names of those men who have provided the machines to utilise the energies of the steam-engine are too often forgotten. Of their inventions the majority of mankind know little. They worked silently at home, in the mill, or in the factory, observed by few. Indeed, in most cases these silent workers had no wish to expose their work to public gaze. Were it not so, the factory and the mill are not places where people go to take the air. How long in the silent night the inventors of these machines sat and pondered; how often they had to cast aside some long sought mechanical movement and seek another and a better arrangement of parts, none but themselves could ever know. They were unseen workers, who succeeded by rare genius, long patience, and indomitable perseverance.

More ingenuity and creative mechanical genius is perhaps displayed in machines used for the manufacture of textile fabrics than by those used in any other industry. It was not until late in historical times that the manufacture of such fabrics became established on a large scale in Europe. Although in China man was clothed in silk long ago, and although Confucius, in a work written 2300 years ago, orders with the greatest minuteness the rules to be observed in the production and manufacture of silk, yet it was worth nearly its weight in gold in Europe in the time of Aurelian, whose empress had to forego the luxury of a silk gown on account of its cost.* Through Constantinople and Italy the manufacture passed slowly westward, and was not established in France until the sixteenth century, and arrived at a still later period in this country. It is related that James V. had to borrow a pair of silk hose from the Earl of Mar, in order that he might not, as he expressed it, appear as a scrub before strangers.

So cotton, of which the manufacture in India dates from before historical times, had scarcely by the Christian Era reached Persia and Egypt. Spain in the tenth, and Italy in the fourteenth century manufactured it, but Manchester, which is now the great metropolis of the trade, not until the latter half of the seventeenth century.

Linen was worn by the old Egyptians, and some of their linen mummy-cloths surpass in fineness any linen fabrics made in later days.† The Babylonians wore linen also, and wool, and obtained a widespread fame for skill in workmanship and beauty in design.

In this country wool long formed the staple for clothing. Silk was the first rival, but its costliness placed it beyond the reach of the many. To introduce a new material or improved machine into this or other countries a century or more ago was no light undertaking. Inventors, and would-be benefactors, alike ran the risk of loss of life. Loud was the outcry made in the early part of

the eighteenth century against the introduction of Indian cottons and Dutch calicoes.

Until 1738, in which year the improvements in spinning machinery were begun, each thread of worsted or cotton-wool had been spun between the fingers in this and all other countries. Wyatt, in 1738, invented spinning by rollers instead of fingers, and his invention was further improved by Arkwright. In 1770 Hargreaves patented the spinning jenny and Crompton the mule in 1775, a machine which combined the advantages of the frames of both Hargreaves and Arkwright. In less than a century after the first invention by Wyatt, double mules were working in Manchester with over 2000 spindles. Improvements in machines for weaving were begun at an earlier date. In 1579 a ribbon loom is said to have been invented at Dantzic, by which from four to six pieces could be woven at one time, but the machine was destroyed and the inventor lost his life.* In 1800 Jacquard's most ingenious invention was brought into use, which, by a simple mechanical operation, determines the movements of the threads which form the pattern in weaving. But the greatest discovery in the art of weaving was wrought by Cartwright's discovery of the power loom, which led eventually to the substitution of steam for manual labour, and enabled a boy with a steam loom to do fifteen times the work of a man with a hand loom.

For complex ingenuity few machines will compare with those used in the manufacture of lace and bobbin net. Hammond, in 1768, attempted to adapt the stocking frame to this manufacture, which had hitherto been conducted by hand. It remained for John Heathcoat to complete the adaptation in 1809, and to revolutionise this branch of industry, reducing the cost of its produce to one-fortieth of what the cost had been before Heathcoat's improvements were effected.

Most of these ingenious machines were in use before Watt's genius gave the world a new motive power in the steam-engine; and, had the steam-engine never been perfected, they would still have enormously increased the productive power of mankind. Water power was applied to many of them; in the first silk-thread mill erected at Derby in 1738, 318 million yards of silk thread were spun daily with one water-wheel.

These are happier times for inventors: keen competition among manufacturers does not let a good invention lie idle now. That which was rejected by old machines as waste is now worked up into useful fabrics by new ones. From all parts of the world new products come—jute from India, flax from New Zealand, and many others which demand new adaptations of old machines or new and untried mechanical arrangements to utilise them. Time would fail me if I were to attempt to enumerate one tithe of these rare combinations of mechanical skill; and, indeed, no one will ever appreciate the labour and supreme mental effort required for their construction who has not himself seen them and their wondrous achievements.

Steamboats, the electric telegraph, and railways, are more within the cognisance of the world at large, and the progress that has been made in them in little more than one generation is better known and appreciated.

It is not more than forty years since one of our scientific men, and an able one too, declared at a meeting of this Association that no steamboat would ever cross the Atlantic; founding his statement on the impracticability, in his view, of a steamboat carrying sufficient coal, profitably, I presume, for the voyage. Yet, soon after this statement was made, the *Sirius* steamed from Bristol to New York in seventeen days,† and was soon followed by the *Great Western* which made the homeward passage in thirteen-and-a-half days; and with these voyages the era of steamboats began. Like most important inventions, that of the steamboat was a long time in assuming a form capable of being profitably utilised; and even when it had assumed such a form, the

* Manufacture of silk brought from China to Constantinople A.D. 522.

† Wilkinson's "Ancient Egyptians;" Pliny, Book xix., c. ii.

* Beckman's "History of Inventions," vol. ii., p. 528.

† First steamer crossed the Atlantic by steam alone in 1838.

objections of commercial and scientific men had still to be overcome.

Among the many names connected with the early progress in the construction of steamboats, perhaps none is more worthy of remembrance than that of Patrick Miller, who, with the assistance of Symington, an engineer, and Taylor, who was his children's tutor, constructed a small steamboat. Shortly afterwards Lord Dundas, who saw the value of the application of steam for the propulsion of boats, had the first really practical steamboat constructed with a view to using it on the Forth and Clyde Canal. The proprietors, however, objected, and the boat lay idle. Again, another attempt to make practical use of the steamboat failed through the death of the Duke of Bridgewater, who, with his characteristic foresight, had seen the value of steam as a motive power for boats, and had determined to introduce steamboats on the canal which bears his name.

The increase in the number of steamboats since the time when the *Sirius* first crossed the Atlantic has been very great. Whereas in 1814 the United Kingdom only possessed two steam vessels, of together 456 tons burden, in 1872 there were on the register of the United Kingdom 3662 steam vessels, of which the registered tonnage amounted to over a million and a half of tons,* or to nearly half the whole steam tonnage of the world, which did not at that time greatly exceed three million tons.

As the number of steamboats has largely increased, so also gradually has their size increased until it culminated in the hands of Brunel in the *Great Eastern*.

A triumph of engineering skill in ship-building, the *Great Eastern* has not been commercially so successful. In this, as in many other engineering problems, the question is not how large a thing can be made, but how large, having regard to other circumstances, it is proper at the time to make it.

If, as regards the dimensions of steamboats, we have at present somewhat overstepped the limits in the *Great Eastern* much still remains to be done in perfecting the form of vessels, whether propelled by steam or driven by the force of the wind. A distinguished member of this Association, Mr. Froude, has now for some years devoted himself to investigations carried on with a view to ascertain the form of vessel which will offer the least resistance to the water through which it must pass. So many of us in these days are called upon to make journeys by sea as well as by land, that we can well appreciate the value of Mr. Froude's labours, so far as they tend to curtail the time which we must spend on our ocean journeys; and we should all feel grateful to him if from another branch of his investigations, which relates to the rolling of ships, it should result that the movement in passenger vessels could be reduced. A gallant attempt in this direction has lately been made by Mr. Bessemer; whether a successful one yet remains to be proved. In any event, he and those who have acted with him deserve our praise for an experiment which must add to our knowledge.

It is a question of vital importance to the steamboat that the consumption of fuel should be reduced to the smallest possible amount, inasmuch as each ton of fuel excludes a ton of cargo.

As improvements in the form of the hull are effected, less power—that is, less fuel—will be required to propel the vessel through the water for a given distance. Great as have been the improvements effected in marine engines to this end, much still remains to be done. Wolf's compound engine, so long overlooked, is, with some improvements, being at last applied. Whereas the consumption of fuel in such vessels as the *Himalaya* used to be from 5 to 6 lbs. of fuel per effective horse-power, it has been reduced, by working steam more expansively in vessels of a later date, to 2 lbs. Yet, comparing this with the total amount of energy of 2 lbs. of coal, it will be found that not a tenth part of the power is obtained

which that amount of coal would theoretically call into action.*

We live in an age when great discoveries are made, and when they are speedily taken advantage of if they are likely to be of service to mankind.

In former times, man's inventions were frequently in advance of the age, and they were laid aside to await a happier era. There were in those earlier days too few persons who cared to, or who could, avail themselves of the proffered boon, and there was no sufficient accumulation of wealth to justify its being appropriated to schemes which are always in their early stage more or less speculative.

There is no more remarkable instance of the rapid utilisation of what was in the first instance regarded by most men as a mere scientific idea, than the adoption and extension of the electric telegraph.

Those who read Odier's letter written in 1773, in which he made known his idea of a telegraph which would enable the inhabitants of Europe to converse with the Emperor of Mogul, little thought that in less than a century a conversation between persons at points so far distant would be possible. Still less did those who saw in the following year messages sent from one room to another by Lesage in the presence of Frederick of Prussia, realise that they had before them the germ of one of the most extraordinary inventions among the many that will render this century famous.

I should weary you were I to follow the slow steps by which the electric telegraph of to-day was brought to its present state of efficiency. In the present century few years have passed without new workers appearing in the field; some whose object was to utilise the new-found power for the benefit of mankind, others—and their work was not the least important in the end—whose object was to investigate magnetism and electrical phenomena as presenting scientific problems still unsolved. Galvani, Volta, Oersted, Arago, Sturgeon, and Faraday, by their labours, helped to make known the elements which rendered it possible to construct the electric telegraph. With the battery, the electric coil, and the electro-magnet, the elements were complete, and it only remained for Sir Charles Wheatstone and others to combine them in a useful and practically valuable form. The inventions of Alexander Stenheil, and those of similar nature to that of Sir Charles Wheatstone, were made known at a later date in the same year, which will ever be memorable in the annals of telegraphy.†

The first useful telegraph was constructed upon the Blackwall Railway in 1838, Messrs. Wheatstone's and Cooke's instruments being employed. From that time to this the progress of the electric telegraph has been so rapid, that at the present time, including land lines and submarine cables, there are in use in different parts of the world not less than 400,000 miles of telegraph.

* Theoretical Energy of 1 lb. of Coal:—

The proportions of heat expended in generating saturated steam at 212° F., and at 14·7 lbs. pressure per square inch, from water at 212° are:

| | Units of heat. | Mechanical equivalent in foot-lbs. |
|--|----------------------|--|
| I. In the formation of steam .. | 892·8 | 689,242 |
| II. In resisting the incumbent pressure of 14·7 lbs. per sq. inch.. .. . | 72·3 | 55,815 |
| | 965·1 | 745,057 |

One pound of Welsh coal will theoretically evaporate 15 lbs. of water at 212° to steam at 212°. Therefore, the full theoretical value of the combustion of 2 lbs. of Welsh coal is

$$2 \times 15 \times 745,057 \text{ foot-pounds,}$$

or

$$\frac{2 \times 15 \times 745,057}{60 \times 33,000} \text{ horse-power, if consumed in 1 hour.}$$

$$= 11·2 \text{ horse-power.}$$

As the consumption of coal per effective horse-power in a marine engine is 2 lbs., the power obtained is to the whole theoretical power as 1 is to 11.

† Dates of patents; Wheatstone, March 1, 1837; Alexander, April 22, 1837; Steinheil, July 1, 1837; Morse, October, 1837.

* Board of Trade Return, July 15, 1874, Table 8.

Among the numerous inventions of late years, the automatic telegraph of Mr. Alexander Bain, of Dr. Werner Siemens, and of Sir Charles Wheatstone, are especially worthy of notice. Mr. Bain's machine is chiefly used in the United States, that of Dr. Werner Siemens in Germany. In this country the machine invented by Sir Charles Wheatstone, to whom telegraphy owes so much, is chiefly employed. By his machine, after the message has been punched out in a paper ribbon by one machine on a system analogous to the dot and dash of Morse, the sequence of the currents requisite to transmit the message along the wire is automatically determined in a second machine by this perforated ribbon. The second operation is analogous to that by which in Jacquard's loom the motions of the threads requisite to produce the pattern is determined by perforated cards. By Wheatstone's machine errors inseparable from manual labour are avoided; and what is of even more importance in a commercial point of view, the time during which the wire is occupied in the transmission of a message is considerably diminished.

By the application of these automatic systems to telegraphy, the speed of transmission has been wonderfully accelerated, being equal to 200 words a minute, that is, faster than a shorthand writer can transcribe; and, in fact, words can now be passed along the wires of land lines with a velocity greater than can be dealt with by the human agency at either end.

Owing partly to the retarded effects of induction and other causes, the speed of transmission by long submarine cables is much smaller. With the cable of 1858 only $2\frac{1}{2}$ words per minute were got through. The average with the Atlantic cable, Dr. C. W. Siemens informs me, is now 17 words, but 24 words per minute can be read.

One of the most striking phenomena in telegraphy is that known as the duplex system, which enables messages to be sent from each end of the same wire at the same time. This simultaneous transmission from both ends of a wire was proposed in the early days of telegraphy, but, owing to imperfect insulation, was not then found to be practicable; but since then telegraphic wires have been better insulated, and the system is now becoming of great utility, as it nearly doubles the capacity for work of every wire.

And yet within how short a period of time has all the wonderful progress in telegraphy been achieved! How incredulous the world a few years ago would have been if then told of the marvels which in so short a space of time were to be accomplished by its agency!

It is not long ago—1823—that Mr., now Sir Francis Ronalds, one of the early pioneers in this field of science, published a description of an electric telegraph. He communicated his views to Lord Melville, and that nobleman was obliging enough to reply that the subject should be inquired into; but before the nature of Sir Francis Ronalds's suggestions could be known, except to a few, that gentleman received a reply from Mr. Barrow, 'that telegraphs of any kind were then wholly unnecessary, and that no other than the one then in use would be adopted;' the one then in use being the old semaphore, which, crowning the tops of the hills between London and Portsmouth, seemed perfection to the Admiralty of that day.

I am acquainted with some who, when the first Transatlantic cable was proposed, contributed towards that undertaking with the consciousness that it was only an experiment, and that subscribing to it was much the same thing as throwing their money into the sea. Much of this cable was lost in the first attempt to lay it; but its promoters, nothing daunted, made 900 miles more cable, and finally laid it successfully in the following year, 1858.

The telegraphic system of the world comprises almost a complete girdle round the earth; and it is probable that the missing link will be supplied by a cable between San Francisco in California and Yokohama in Japan.

How resolute and courageous those who engaged in submarine telegraphy have been will appear from the fact that,

though we have now 50,000 miles of cable in use, to get at this result nearly 70,000 miles were constructed and laid. This large percentage of failure, in the opinion of Dr. C. W. Siemens (to whom I am much indebted for information on this subject), was partly due to the late introduction of testing a cable under water before it is laid, and to the use of too light iron sheathing.

Of immense importance in connection with the subsequent extension of submarine cables have been the discoveries of Ohm and Sir William Thomson, and the knowledge obtained that the resistance in wire of homogeneous metal is directly proportional to the length, so that the place of a fault in a cable of many thousand miles in length can be ascertained with so much precision as to enable you to go at once to repair it, although the damaged cable may lie in some thousands of fathoms of water.

Of railways the progress has been enormous; but I do not know that in a scientific point of view a railway is so marvellous in its character as the electric telegraph. The results, however, of the construction and use of railways are more extensive and wide spread, and their utility and convenience brought home to a larger portion of mankind. It has come to pass, therefore, that the name of George Stephenson has been placed second only to that of James Watt; and as men are and will be estimated by the advantages which their labours confer on mankind, he will remain in that niche, unless indeed some greater luminary should arise to outshine him. The merit of George Stephenson consisted, among other things, in this, that he saw more clearly than any other engineer of his time the sort of thing that the world wanted, and that he persevered in despite of learned objectors with the firm conviction that he was right and they were wrong, and that there was within himself the power to demonstrate the accuracy of his convictions.

Railways are a subject on which I may (I hope without tiring you) speak somewhat more at length. The British Association is peripatetic, and without railways its meetings, if held at all, would, I fear, be greatly reduced in numbers. Moreover, you have all an interest in them: you all demand to be carried safely, and you insist on being carried fast. Besides, everybody understands, or thinks he understands, a railway, and therefore I shall be speaking on a subject common to all of us, and shall possibly only put before you ideas which others as well as myself have already entertained.

We who live in these days of roads and railways, and can move with a fair degree of comfort, speed, and safety, almost where we will, can scarcely realise the state of England two centuries ago, when the years of opposition which preceded the era of coaches began; when, as in 1662, there were but six stages in all England, and John Crossdell, of the Charterhouse, thought there were six too many; when Sir Henry Herbert, a member of the House of Commons, could say, 'If a man were to propose to carry us regularly to Edinburgh in coaches in seven days, and bring us back in seven more, should we not vote him to Bedlam?'

In spite of short-sighted opposition, coaches made their way; but it was not until a century later, in 1784—and then I believe it was in this city of Bristol—that coaches were first established for the conveyance of mails. Those here who have experienced, as I have, what the discomforts were of long journeys inside the old coaches, will agree with me that they were very great; and I believe, if returns could be obtained of the accidents which happened to coaches, it would be found that many more people were injured and killed in proportion to the number that travelled by that mode, than by the railways of to-day.

No sooner had our ancestors settled down with what comfort was possible in their coaches, well satisfied that twelve miles an hour was the maximum speed to be obtained or that was desirable, than they were told that steam conveyance on iron railways would supersede their

'present pitiful' methods of conveyance. Such was the opinion of Thomas Gray, the first promoter of railways, who published his work on a general iron railway in 1819. Gray was looked on as little better than a madman. 'When Gray first proposed his great scheme to the public,' said Chevalier Wilson, in a letter to Sir Robert Peel in 1845, 'people were disposed to treat it as an effusion of insanity.' I shall not enter on a history of the struggles which preceded the opening of the first railway. They were brought to a successful issue by the determination of a few able and far-seeing men. The names of Thomas Gray and Joseph Sandars, of William James and Edward Pease, should always be remembered in connection with the early history of railways, for it was they who first made the nation familiar with the idea. There is no fear that the name of Stephenson will be forgotten, whose practical genius made the realisation of the idea possible.

The Stockton and Darlington Railway was opened in 1825, the Liverpool and Manchester Railway in 1830, and in the short time which has since elapsed, railways have been extended to every quarter of the globe. No nation possessing wealth and population can afford to be without them; and though at present in different countries there is in the aggregate about 160,000 miles of railway, it is certain that in the course of a very few years this quantity, large as it is, will be very greatly exceeded.

Railways add enormously to the national wealth. More than 25 years ago it was proved to the satisfaction of a committee of the House of Commons, from facts and figures which I then adduced, that the Lancashire and Yorkshire Railway, of which I was the engineer, and which then formed the principal railway connection between the populous towns of Lancashire and Yorkshire, effected a saving to the public using the railway of more than the whole amount of the dividend which was received by the proprietors. These calculations were based solely on the amount of traffic carried by the railway, and on the difference between the railway rate of charge and the charges by the modes of conveyance anterior to railways. No credit whatever was taken for the saving of time, though in England pre-eminently time is money.

Considering that railway charges on many items have been considerably reduced since that day, it may be safely assumed that the railways in the British Islands now produce, or rather save to the nation, a much larger sum annually than the gross amount of all the dividends payable to the proprietors, without at all taking into account the benefit arising from the saving in time. The benefits under that head defy calculation, and cannot with any accuracy be put into money; but it would not be at all over-estimating this question to say that in time and money the nation gains at least what is equivalent to 10 per cent. on all the capital expended on railways. I do not urge this on the part of railway proprietors, for they did not embark in these undertakings with a view to the national gain, but for the expected profit to themselves. Yet it is as well it should be noted, for railway proprietors appear sometimes by some people to be regarded in the light of public enemies.

It follows from these facts that whenever a railway can be made at a cost to yield the ordinary interest of money, it is in the national interest that it should be made. Further, that though its cost might be such as to leave a smaller dividend than that to its proprietors, the loss of wealth to so small a section of the community will be more than supplemented by the national gain, and therefore there may be cases where a government may wisely contribute in some form to undertakings which, without such aid, would fail to obtain the necessary support.

And so some countries, Russia for instance, to which improved means of transport are of vital importance, have wisely, in my opinion, caused lines to be made which, having regard to their own expenditure and receipts, would be unprofitable works, but in a national point of view are, or speedily will be, highly advantageous.

The Empire of Brazil also, which I have lately visited, is arriving at the conclusion, which I think not an unwise one, that the State can afford and will be benefited in the end by guaranteeing 7 per cent. upon any railway that can of itself be shown to produce a net income of 4 per cent., on the assumption that the nation will be benefited at least to the extent of the difference.

A question more important probably in the eyes of many—safety of railway travelling—may not be inappropriate. At all events, it is well that the elements on which it depends should be clearly understood. It will be thought that longer experience in the management of railways should go to ensure greater safety, but there are other elements of the question which go to counteract this in some degree.

The safety of railway travelling depends on the perfection of the machine in all its parts, including the whole railway, with its movable plant, in that term; it depends also on the nature and quantity of traffic, and lastly, on human care and attention.

With regard to what is human, it may be said that so many of these accidents as arise from the fallibility of men will never be eliminated until the race be improved.

The liability to accident will also increase with the speed, and might be reduced by slackening that speed. It increases with the extent and variety of the traffic on the same line. The public, I fear, will rather run the risk than consent to be carried at a slower rate. The increase in extent and variety of traffic is not likely to receive any diminution; on the contrary, it is certain to augment.

I should be sorry to say that human care may not do something, and I am not among those who object to appeals through the press, and otherwise to railway companies, though sometimes perhaps they may appear in an unreasonable form. I see no harm in men being urged in every way to do their utmost in a matter so vital to many.

A question may arise whether, if the railways were in the hands of the Government, they could not be worked with greater safety. Government would not pay their officers better, or perhaps so well as the companies do, and it is doubtful whether they would succeed in attracting to the service abler men. They might do the work with a smaller number of chief officers, for much of the time of the companies' managers is occupied in interne-cine disputes. They might handle the traffic more despotically, diminishing the number of trains, or the accommodation afforded by them, or in other ways, to insure more safety; but would the public bear any curtailment of convenience?

One thing they could, and perhaps would do. In cases where the traffic is varied, and could more safely be conducted with the aid of relief lines, which hold out no sufficient inducement to the companies to make, the Government, being content with a lower rate of interest, might undertake to make them, though then comes the question whether, when the whole of this vast machine came to depend for supplies on annual votes of Parliament, money would be forthcoming in greater abundance than it is under the present system.

But the consideration of this subject involves other and more difficult questions.

Where are the labours of Government to stop? The cares of State which cannot be avoided are already heavy, and will grow heavier every year. Dockyard establishments are trifling to what the railway establishments, which already employ 250,000 men, would be. The assumption of all the railways would bring Government into conflict with every passenger, every trader, every merchant, and every manufacturer. With the railway companies there would be no difficulty; they would sell their undertakings to anyone provided their price was ample.

Looking at the vast growth of railway traffic, one measure occurs to me as conducive to the safety of rail-

way passengers, and likely to be demanded some day: it is to construct between important places railways which should carry passengers only or coals only, or be set apart for some special separation of traffic; though there will be some difficulty in accomplishing this. Landowners, through whose properties such lines would pass, would probably wish to use such lines for general purposes. Nevertheless, it may have to be tried some day.

It would be instructive, were it practicable, to compare the relative proportion of accidents by railway and by the old stage coaches, but no records that I am aware of exist of the latter that would enable such a comparison to be made. It is practicable to make some sort of comparison between the accidents in the early days of our own railways and the accidents occurring at a later date.

The Board of Trade have unfortunately abandoned the custom, which they adopted from 1852 to 1859, of returning the passenger mileage, which is given in the German returns, and is the proper basis upon which to found the proportion of accidents, and not on the number of passengers without any regard to distance travelled, which has altered very much, the average journey per passenger being nearly half in 1873 what it was in 1846.

It would be erroneous to compare the proportions of accidents to passengers carried in various years, even if the correct number of passengers travelling were given. But a figure is always omitted from the Board of Trade return, which makes the proportion of accidents to passengers appear larger than it is; this is the number of journeys performed by season-ticket holders. Some estimate could be made of the journeys of season-ticket holders by dividing the receipts by an estimated average fare, or the companies could make an approximate estimate, and the passenger mileage could be readily obtained by the railway companies from the tickets. These additions would greatly add to the value of the railway returns as statistical documents, and render the deductions made from them correct.

Though it has been a work of labour, I have endeavoured to supply these deficiencies, and I believe the results arrived at may be taken as fairly accurate.

From the figures so arrived at, it appears the passenger mileage has doubled between 1861 and 1873; and at the rate of increase between 1870 and 1873 it would become double what it was in 1873 in twelve years from that time, namely in 1885.

The number of passengers has doubled between 1864 and 1873, and at the rate of increase between 1870 and 1873 it would become double what it was in 1873 in eleven-and-a-half years, or in 1885.

It must, however, be remembered that the rate of increase since 1870, though very regular for 1871, 1872, and 1873, is greater than in previous years, being probably due to the rise of wages and the great development of third-class traffic, and it would not be safe to assume this rate of increase will continue.

Supposing no improvement had been effected in the working of railway traffic, by the interlocking of points, the block system, &c., the increase of accidents should have borne some proportion to the passenger mileage, multiplied by the proportion between the train mileage and the length of line open, as the number of trains passing over the same line of rails would tend to multiply accidents in an increasing proportion, especially where the trains run at different speeds.

The number of accidents varies considerably from year to year, but, taking two averages of ten years each, it appears that the proportion of deaths of passengers from causes beyond their control to passenger miles travelled in the ten years ending December 31, 1873, was only two-thirds of the same proportion in the ten years ending December 31, 1861; the proportion of all accidents to passengers from causes beyond their own control was one-ninth more in the last ten years than in the earlier, whereas

the frequency of trains had increased, on the average, one-fourth.

The limit, however, of considerable improvements in signalling, increased brake power, &c., will probably be reached before long, and the increase of accidents will depend on the increase of traffic, together with the increased frequency of trains.

The large growth of railway traffic, which we may assume will double in twenty years, will evidently greatly tax the resources of the railway companies; and unless the present companies increase the number of lines of way, as some have commenced to do, or new railways are made, the system of expeditious and safe railway travelling will be imperilled. Up to the present time, however, the improvements in regulating the traffic appear to have kept pace with the increase of traffic and of speed, as the slight increase in the proportion of railway accidents to passenger miles is probably chiefly due to a larger number of trifling bruises being reported now than formerly.

I believe it was a former President of the Board of Trade who said to an alarmed deputation, who waited upon him on the subject of railway travelling, that he thought he was safer in a railway carriage than anywhere else.

If he gave any such opinion, he was not far wrong, as is sufficiently evident when it can be said that there is only one passenger injured in every four million miles travelled, or that, on an average, a person may travel 100,000 miles each year for forty years, and the chances be slightly in his favour of his not receiving the slightest injury.

A pressing subject of the present time is the economy of fuel. Members of the British Association have not neglected this momentous question.

At the meeting held at Newcastle-on-Tyne in 1863, Sir William Armstrong sounded an alarm as to the proximate exhaustion of our coal-fields.

Mr. Bramwell, when presiding over the Mechanical Section at Brighton, drew attention to the waste of fuel.

Dr. Siemens, in an able lecture he delivered by request of the Association to the operative classes at the meeting at Bradford, pointed out the waste of fuel in special branches of the iron trade, to which he has devoted so much attention.

He showed on that occasion that, in the ordinary reheating furnace, the coal consumed did not produce the twentieth part of its theoretical effect, and in melting steel in pots in the ordinary way not more than one-seventieth part; in melting one ton of steel in pots about $2\frac{1}{2}$ tons of coke being consumed. Dr. Siemens further stated that, in his regenerative gas furnace, one ton of steel was melted with 12 cwts. of small coal.

Mr. Lowthian Bell, who combines chemical knowledge with the practical experience of an ironmaster, in his Presidential address to the members of the Iron and Steel Institute in 1873, stated that, with the perfect mode of withdrawing and utilising the gases and the improvement in the furnaces adopted in the Cleveland district, the present make of pig-iron in Cleveland is produced with $3\frac{1}{2}$ million tons of coal less than would have been needed fifteen years ago; this being equivalent to a saving of 45 per cent of the quantity formerly used. He shows, by figures with which he has favoured me, that the calorific power of the waste gases from the furnaces is sufficient for raising all the steam and heating all the air the furnaces require.

It has already been stated that, by working steam more expansively, either in double or single engines, the consumption of fuel in improved modern engines compared with the older forms may be reduced to one-third.

All these reductions still fall far short of the theoretical effect of fuel which may be never reached. Mr. Lowthian Bell's figures go to show that in the interior of the blast furnace, as improved in Cleveland, there is not much more to be done in reducing the consumption of fuel; but much has already been done, and could the reductions now attainable, and all the information already acquired,

be universally applied, the saving in fuel would be enormous.

How many open blast furnaces still belch forth flame and gas and smoke as uselessly, and with nearly as much mischief to the surrounding neighbourhood, as the fires of Etna or Vesuvius?

How many of the older and more extravagant forms of steam-engine still exist?

What is to be done with the intractable householder with the domestic hearth, where, without going to German stoves, but by using Galton's grates and other improvements, everything necessary both for comfort and convenience could be as well attained with a much smaller consumption of coal?

If I have pointed out that we do not avail ourselves of more than a fractional part of the useful effects of fuel, it is not that I expect we shall all at once mend our ways in this respect.

Many cases of waste arise from the existence of old and obsolete machines, of bad forms of furnaces, of wasteful grates, existing in most dwelling-houses; and these are not to be remedied at once, for not everyone can afford, however desirable it might be, to cast away the old and adopt the new.

In looking uneasily to the future supply and cost of fuel, it is, however, something to know what may be done even with the application of our present knowledge; and could we apply it universally to-day, all that is necessary for trade and comfort could probably be as well provided for by one-half the present consumption of fuel; and it behoves those who are beginning to build new mills, new furnaces, new steamboats, or new houses, to act as though the price of coal which obtained two years ago had been the normal, and not the abnormal price.

There was in early years a battle of the gauges, and there is now a contest about guns; but your time will not permit me to say much on their manufacture.

Here, again, the progress made in a few years has been enormous; and in contributing to it, two men, Sir William Armstrong and Sir Joseph Whitworth, both civil engineers, in this country at all events, deservedly stand foremost. The iron coil construction of Sir William Armstrong has already produced remarkable and satisfactory results; in discussing further possible improvements, the question is embarrassed by attempting to draw sharp lines between what is called steel and iron.

There is nothing that I can see to limit the size of guns, except the tenacity and endurance of the metal, whatever we may choose to call it, of which they are to be made.

Sir Joseph Whitworth, who has already done more than any other man in his department to secure good workmanship, and whose ideal of perfection is ever expanding, has long been seeking, and not without success, by enormous compression, to increase those qualities in what he calls homogeneous metal. Make the metal good enough, and call it iron if you will, and the size of a gun may be anything: the mere construction and handling of a gun of 100 tons, or of far greater weight, with suitable mechanical appliances, presents no difficulty.

Relying on the qualities of his compressed metal, Sir Joseph is now seeking, by a singular experiment, to limit the travel of the recoil, as far as practicable, to the elasticity of the metal. By attaching the muzzle of the gun to an outer casing, through which the force of the recoil is carried back to the trunnions, he proposes to avail himself of this elasticity to the extent of one-and-a-half times the length of the gun; whether its elasticity alone in so short a space will suffice without other aid is, perhaps, doubtful; but other aid may be applied, and the experiment, whether successful or not, will be interesting.

Docks and harbours I have no time to mention, for it is time this long and, I fear, tedious address, should close.

"Whence and whither" is an aphorism which leads us away from present and plainer objects to those which are more distant and obscure; whether we look backwards or

forwards, our vision is speedily arrested by an impenetrable veil.

On the subjects I have chosen you will probably think I have travelled backwards far enough. I have dealt to some extent with the present.

The retrospect, however, may be useful to show what great works were done in former ages.

Some things have been better done than in those earlier times, but not all.

In what we choose to call the ideal we do not surpass the ancients. Poets and painters and sculptors were as great in former times as now; so, probably, were the mathematicians.

In what depends on the accumulation of experience, we ought to excel our forerunners. Engineering depends largely on experience; nevertheless, in future times whenever difficulties shall arise or works have to be accomplished for which there is no precedent, he who has to perform the duty may step forth from any of the walks of life, as engineers have not unfrequently hitherto done.

The marvellous progress of the last two generations should make everyone cautious of predicting the future. Of engineering works, however, it may be said that their practicability or impracticability is often determined by other elements than the inherent difficulty in the works themselves. Greater works than any yet achieved remain to be accomplished—not, perhaps, yet awhile. Society may not yet require them; the world could not at present afford to pay for them.

The progress of engineering works, if we consider it, and the expenditure upon them, has already in our time been prodigious. One hundred and sixty thousand miles of railway alone, put into figures at £20,000 a mile, amounts to 3200 million pounds sterling; add 400,000 miles of telegraph at £100 a mile, and 100 millions more for sea canals, docks, harbours, water and sanitary works constructed in the same period, and we get the enormous sum of 3340 millions sterling expended in one generation and a half on what may undoubtedly be called useful works.

The wealth of nations may be impaired by expenditure on luxuries and war; it cannot be diminished by expenditure on works like these.

As to the future, we know we cannot create a force; we can, and no doubt shall, greatly improve the application of those with which we are acquainted. What are called inventions can do no more than this; yet how much every day is being done by new machines and instruments!

The telescope extended our vision to distant worlds. The spectroscope has far outstripped that instrument, by extending our powers of analysis to regions as remote.

Postal deliveries were and are great and able organisations, but what are they to the telegraph?

Need we try to extend our vision into futurity farther? Our present knowledge, compared to what is unknown even in physics, is infinitesimal. We may never discover a new force—yet, who can tell?

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Earl DUCIE proposed a vote of thanks to the President, which was seconded by Mr. HODGSON, M.P.

The MAYOR of BRISTOL welcomed, on behalf of his fellow citizens, the British Association to Bristol. He trusted the members who had come there would have already seen that the city of Bristol duly appreciated the visit of the British Association. It was very true that forty years had elapsed since the British Association had been in Bristol; but he ventured to say, from the interest taken in this visit, no such period would elapse before they again saw the British Association. He had very great pleasure in putting to them the motion of a vote of thanks to their worthy President, Sir John Hawkshaw. They had already passed that vote by acclamation, and he put it to them formally.

The motion was carried, and the proceedings then terminated.

At 1 o'clock on Wednesday a meeting of the General Committee was held in the Museum, Dr. CARPENTER presiding. The Report stated that the Resolution urging the Government of India to continue the solar observations in India had been submitted to the Government, and a reply had been received from Lord Salisbury intimating that an establishment would be employed at Roorkee during the year 1875-76 to take observations of the sun and of satellites. Another Resolution requesting the Government to undertake an Arctic Expedition had been complied with, and the Expedition had already been despatched. Invitations in regard to the holding of the meeting for 1877 have been received from Plymouth and Leeds. The usual formal resolutions for the appointment of officers for the meeting at Glasgow next year were adopted.

The number of tickets taken up to Thursday evening, by members and associates, was 2206.

A soirée, under the auspices of the Bristol and Bath Natural History Societies, was held in the Colston Hall last night, which was numerously attended. A large number of microscopes were exhibited.

The foreign visitors present at the meeting include M. Charles Buls, Brussels; Professor Léon Vanderkindere, University of Brussels; Dr. Alphons Oppenheim, Berlin; H. A. Rowland, Baltimore; Dr. James K. Patterson, Kentucky University; Dr. S. Nachtigal, Berlin; Chevalier Dr. G. W. Leitner, Lahore, India; M. Ch. Bergeron, C.E., Paris; Jas. J. Skinner, Ph.B., C.E., Yale College, New Haven; Dr. E. L. Youmans, New York.

SECTION B. CHEMICAL SCIENCE.

President—Professor A. G. Vernon Harcourt, M.A., F.R.S.

Vice-Presidents—Professor Atkinson; Professor Debus, F.R.S.; Professor J. H. Gladstone, F.R.S.; Dr. Longstaff; Professor N. Story Maskelyne, F.R.S.; T. Proctor; Professor W. J. Russell, F.R.S.; Professor Williamson, F.R.S.

Secretaries—H. E. Armstrong, Ph.D.; W. Chandler Roberts, F.R.S.; William A. Tilden, D.Sc.

Committee—A. H. Allen; Professor J. Attfield; H. Bauerman; H. B. Brady, F.R.S.; W. Lant Carpenter, B.Sc.; M. Carteighe; Professor Corfield, M.D.; R. Calvert Clapham; W. W. Fisher; A. E. Fletcher; T. B. Groves; Professor Guthrie, F.R.S.; A. S. Hobson; Professor G. C. Foster; S. Lupton, M.A.; Professor McLeod; W. Weldon; P. J. Worsley, B.Sc.; T. Wills; G. F. Rodwell; G. F. Schacht; J. Smyth; W. W. Stoddart; Professor T. E. Thorpe; Charles Thomas.

The proceedings of this section were opened at eleven o'clock yesterday morning at Freemasons' Hall, by the reading of the President's address, which we shall publish *in extenso* in our next number.

Professor A. W. WILLIAMSON in eloquent terms proposed a vote of thanks to Professor Vernon Harcourt for his address, which was seconded by Professor J. Attfield.

Professor T. E. THORPE then read a Report of the Committee for the purpose of "Determining the Specific Volumes of Liquids."

Mr. W. CHANDLER ROBERTS, F.R.S., presented the Report of the Committee for the purpose of "Investigating the Methods of making Gold Assays, and stating the Results thereof."

The President, Professor A. VERNON HARCOURT, described an "Apparatus for Estimating Carbon Bisulphide in Coal Gas."

The reading of the following papers concluded the first meeting of the section:—"Some Account of the Manufacture and Refining of Sugar in Bristol, 1875," by Mr. Henry T. Chamberlain; "The Tobacco Trade of Bristol," by Mr. Thomas Davey; "A Simple Method of Determining the Proportion of Carbonic Acid in Air," by Mr. A. S. Davis;

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 79.)

OZONE has never been obtained in a state of purity.

All chemical methods, as well as the electrolysis of water, yield it only very sparingly, since not merely reducing agents, but even oxidisers—all super-oxides for instance—re-convert ozone into ordinary oxygen. The example of barium super-oxide shows this in the following equation:— $O_3 + BaO_2 = 2O_2 + BaO$.

Connections of cork and caoutchouc cannot be used in an ozone apparatus, on account of their oxidisability. The electric spark has also a destructive action upon ozone. The best procedure for its preparation is, therefore, silent discharge with the aid of a Ruhmkorff's apparatus in induction-tubes, filled with oxygen. The greatest contraction which Andrews and Tait observed in oxygen thus treated was one-twelfth. This, as has been shown above, amounts to the transformation of one-fourth of the oxygen present into ozone.

An instrument of this kind, of a simple construction, was described by Werner Siemens† in 1857. Brodie‡ has recently defended the claims of this eminent physicist in opposition to supposed recent inventors, especially Houzeau. Wills|| gave the instrument a less fragile form, and with this modification it has been recently introduced into trade by the English mechanics, Tisley and Spiller.§ It has the advantage that it can be cooled by the passage of a current of water. As Siemens recommended the application of the thinnest possible glass it remains to be decided whether the more solid form may not involve a reduction of the yield of ozone.

Siemens's instrument consists essentially of two concentric tubes of glass, the inner tube being lined with tinfoil within, and the exterior coated with the same material without. The inner tube is closed at one end, and is sealed to the outer tube in such a manner that an interval remains between them. The outer tube is drawn out at one end to a thin junction piece, and a similar one is fused to it at the other end. Oxygen circulates in the interval. If the wire ends of the Ruhmkorff's apparatus are brought in contact with the tinfoil coating of the tubes, the intervening space becomes luminous, and the oxygen present is ozonized. Rumine¶ in England and Löw in France,** patented, in 1872, a process for obtaining ozone by blowing cold air into the Bunsen flame. There is no information as to the results of this process.

A patent obtained in England, and specified far from clearly, for obtaining ozone by boiling seaweed,†† may be mentioned as a curiosity, and also the credulity with which ozone-baths, prepared in this manner, find a ready sale, in spite of, or perhaps rather on account of, their high price. It appears at any rate that an industrial method of obtaining ozone is hitherto an unfulfilled desideratum.

(To be continued)

POTASSIUM CYANATE AND UREA.

By CHICHESTER A. BELL, M.B.

HAVING on several occasions lately been in want of small quantities of potassium cyanate, a salt not readily pro-

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Siemens, *Pogg. Ann.*, cii., 120.

‡ Brodie, *Nature*, Feb. 18, 1874.

|| Wills, *Ber. Chem. Ges.*, vi., 769.

§ *Nature*, viii. (1873), 148.

¶ Rumine, *Ber. Chem. Gesell.*, v., 123.

** Löw, *Ber. Chem. Gesell.*, v., 740.

†† *Berl. Chem. Gesell.*, vi., 543.

curable in the shops, the many inconveniences attending its preparation by the usual processes, as well as the varying quantities obtainable, induced me to seek for some more convenient and equally productive method. As the result of a few experiments in this direction, I venture to suggest the following modification of Liebig's well-known process, which will be found rapid and easy of execution, requiring no previous acquaintance with its details, and in the end economical both of time and material:—4 parts of perfectly dried and finely powdered potassium ferrocyanide are intimately mixed with 3 parts of dry and pulverised potassium bichromate. A small quantity of this mixture is placed in a porcelain or iron dish, the temperature of which is then raised until a tender-like combustion takes place, and the mixture blackens, which happens considerably below a red heat. The rest of the mixture is then thrown in by small portions at a time, each successive portion being allowed to blacken completely before it is covered by the next. This is necessary, inasmuch as if air be excluded during the combustion a considerable quantity of potassium cyanide will be found unoxidised. When all the mixture has been thus gradually added the lamp is removed and the dish allowed to cool completely. The result of the reaction, which occupies but a few minutes, even for a considerable quantity of material, is a porous friable mass, from which the cyanate may be extracted with the greatest ease in the usual manner by boiling alcohol. Methylated spirit which has been freed from a part of its water by standing over potassium carbonate, and rectified, answers the purpose admirably. In order to diminish as much as possible the loss from conversion of the cyanate into carbonate during boiling, and also to economise alcohol, it is advisable to add to the latter at each boiling only about as much of the mixture as can be thoroughly exhausted by it. The filtration takes place so rapidly that it is not necessary to employ a hot-water funnel, and the crystallisation of the cyanate may be hastened by immersing the vessel containing its alcoholic solution in cold water. The mother-liquor may be used an indefinite number of times in subsequent boilings. In a favourable experiment the resulting cyanate, equal to about 42 per cent of the dried ferrocyanide, contained less than 1 per cent of impurity.

To obtain the insoluble cyanates, lead, silver, &c., it is only necessary to exhaust the black mass with very cold water, to treat the filtered solution with barium nitrate, in order to remove the chromate and any unaltered ferrocyanide, and finally to precipitate with a nitrate of the metal.

From the above aqueous solution urea may obviously be prepared by the addition to it of 4½ parts of ammonium sulphate, evaporation to dryness, extraction with boiling alcohol, &c. Even from so small a quantity as one ounce of the dried ferrocyanide it is thus possible to obtain in a short time and with little trouble about 25 per cent pure urea. In this form the experiment would furnish a capital exercise for students.

I may here remark that for the purification of urea on the small scale, amylic alcohol will be found a much more convenient crystallising medium than ordinary alcohol.

Stevens's Hospital Laboratory, Dublin.

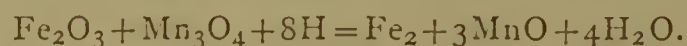
ESTIMATION OF MANGANESE IN SPIEGELEISEN, IRON, AND STEEL.

By SERGIUS KERN, St. Petersburg.

THE methods now used for the estimation of manganese are very complicated, and in the hands of inexperienced analysts often give faulty results, even when the analyses are very carefully made. The method of precipitation of the manganese in the form of hydrated manganese dioxide ($3\text{MnO}_2 \cdot \text{H}_2\text{O}$) by means of bromine, requires much labour, time (not less than 20—24 hours), and the work is very troublesome on account of the strong irritating smell of the bromine. In order to find out a better method I

made numerous trials, and the following process for the estimation of manganese is, as I believe, a very easy method. Indeed, while analysing iron samples by my process, I found the percentage of manganese sometimes a little too high, but the incorrectness of the percentage was so small that it could have no influence in metallurgical operations. I destine my method especially for laboratories of iron and steel works, where analyses of such kind are frequent, and where a rapid estimation of manganese is necessary.

One gramme of the substance in the form of powder is dissolved in 30 cub. centim. of hydrochloric acid. The solution is heated during 30—40 minutes to allow the chemically combined carbon to fly away in the form of carburetted hydrogen; the liquor is evaporated to the half of the original solution, and water is then added. Silica (SiO_2) if it occurs in the substance is found as a precipitate; it is filtered from the solution, well washed, and the washing-waters are poured into the solution, to which is added an *excess* of hydrate of potassium (HKO). In this case the alumina (Al_2O_3) which may be found in the analysed sample remains in solution, and the hydrated ferrous and manganous oxides ($\text{Fe}(\text{OH})_2$ and $\text{Mn}(\text{OH})_2$) fall down in the form of precipitates. These oxides are separated from the liquor, washed, dried, and ignited over a strong fire in the presence of air: thus ferric oxide (Fe_2O_3) and mangano-manganic oxide (Mn_3O_4) are formed. This mixture, in the form of a powder, is introduced into a small hard glass tube, and heated by means of a spirit-lamp; whilst through the tube a current of pure hydrogen is passed. In about 15—20 minutes the operation is finished; the mass in the tube then commences to be greenish, owing to the formation of manganese monoxide (MnO), because, as it is known, the hydrogen reduces the iron-oxides into metallic state, but the manganese oxides only to the state of manganese monoxide. The reactions may be represented by the following equation—



The tube is cooled and the hydrogen is all the time passed over the mass, as the reduced iron in a finely divided state takes fire when exposed to the air. When the tube is cold it is thrown into a metallic cup with pure naphtha oil. The oil before being used is boiled in order to free it from the dissolved oxygen of the air. If the remainder from the operation cannot be easily separated from the tube, the tube may be broken, and the residue is then carefully powered under the naphtha, and the iron is collected by means of a magnet. The remaining manganese oxide is washed and ignited in the presence of air; the substance turns brown with the formation of mangano-manganic oxide (Mn_3O_4). The Mn_3O_4 obtained is accurately weighed; knowing that mangano-manganic oxide contains 72.05 per cent of manganese it is not difficult to calculate the percentage of manganese in the analysed sample.

SOCIETY OF PUBLIC ANALYSTS.

REPORTS OF PUBLIC ANALYSTS.

Of a number of Quarterly Reports presented recently to their respective appointing bodies by various Public Analysts, we may notice the following:—

Dr. Tripe, Analyst for the Borough of Hackney, reports that during the last quarter he has examined, in all, 120 samples, including 31 samples of wine, spirits, and beer, which were obtained simply to ascertain the general quality, notice not being given to the vendors at the time of purchase.

The pickles analysed were found to be pure, except in one case, where turmeric had been added, but this was not reckoned as an adulteration.

Of 21 samples of milk, 2 had had water added, and more than half the total number had been skimmed. In spite

of this, however, the Analyst considers that the milk supply shows a "very decided improvement" as compared with last year.

Tea, coffee, sugar, bread, sweatmeats, lard, and pepper were all found to be unadulterated, and, although much of the tea was very inferior in quality, and though the coffee supplied to the inspector was pure, Dr. Tripe expresses a doubt whether the ordinary purchasers are so fortunate as to get it without chicory.

Of 9 samples of butter, one was found to be grossly adulterated with foreign fats.

Six samples of iodide of potassium were found to be pure.

The remaining samples of wines, spirits, and beer were of very low quality. The wines were all bad, and one sample of sherry "was merely a mixture of coarse spirit, sugar, colouring and flavouring matter."

Three samples of brandy were, respectively, 17, 30, and 40 under proof, and the poorest of them "gave as a distillate a coarse, fiery, offensive spirit without any brandy flavour whatever."

Four samples of gin varied between 37 and 47 under proof, and the samples of whiskey from 22 to 25 under proof. The rum examined was of fair quality.

The samples of porter had been reduced with water in proportions varying from 10 to 33 per cent, besides an excess of salt being, in one instance, present.

In four out of five of the samples, the bitter was not that of hops, and this applied also to some of the samples of ale, which were, however, on the whole, superior in quality to the porter.

Mr. Stoddart reports that, in the county of Somerset, the results of the food analysis for the last quarter show a "marked improvement." He has analysed, in all, 82 samples, of which 17 were adulterated, including samples of tea, coffee, mustard, and milk.

Dr. Stevenson reports that, in St. Pancras, he has examined 47 samples of various substances, all of which were pure except milk, 12 samples of which (out of a total of 29) were adulterated with water, the maximum quantity added being 30 per cent, besides which the cream had in several instances been removed.

Mr. Wigner reports that, in the three districts of Greenwich, Plumstead, and Woolwich, he has, during the last quarter, analysed 101 samples, of which 20 were adulterated. These comprised 17 of milk (out of 47 samples) and 3 of coffee (out of 8 samples). Mr. Wigner considers these results, on the whole, good, but points out that there appears to be no decrease in the practice of adulterating milk with water in the districts for which he acts.

NOTICES OF BOOKS.

A Manual of Dyeing and Dyeing Receipts. By JAMES NAPIER, F.R.S.E., F.C.S., &c. Third Edition. London: Charles Griffin and Co.

WHEN this work first appeared, some 20 years ago, it was simply a collection of dyeing receipts. In that state it enjoyed a considerable circulation, deriving an additional value from the fact that the author's practical experience had been obtained in the dye-works of western and south-western Scotland. It afforded, therefore, the means of comparing the procedures of Scotch dyers with the methods followed respectively in the Lancashire, Yorkshire, West of England, Leicester, and Coventry districts.

Since the date of its first issue, the art of dyeing has undergone a revolution almost equal to a re-creation. The introduction of the coal-tar products, and of other artificial colours, has gone far to render all earlier works on the art obsolete. We need not, therefore, feel surprised that the author has deemed it necessary to produce a new and a greatly-modified edition. In its present form it may be said to offer a systematic treatise on chemistry and physics from the point of view most likely to interest

a dyer. Many substances are, of course, mentioned which have no direct or known bearing upon tinctorial operations. As, however, it is now felt to be desirable that the dyer should have a general acquaintance with chemistry, the notice of such bodies cannot be condemned as irrelevant. Those substances which figure daily in the operations of the dye-house are naturally described in detail. Next follows a chapter on mordants, considered both theoretically and practically, with receipts for the preparation of red spirits, barwood spirits, plum spirits, &c. It is remarkable that in another section of the work (p. 345) we find another and slightly different set of receipts for the very same compounds. If we turn back to p. 158, under the head "Tin," we find a third set of instructions for the preparation of dyer's spirits. It would have been better, surely, to have placed all these receipts together, and to have struck out all that are mere repetitions. From mordants, the author passes on to a description of vegetable colouring matters, the coal-tar dyes being added as an appendix. The distribution of space is certainly not in harmony with the relative importance of the subjects. Thus the coal-tar colours are described in thirteen pages, whilst Wongshy and Sooranjee which are mere curiosities occupy each nearly one-third of that space.

Turmeric is mentioned as a substance "formerly used in dyeing." As lately as 1870 it was certainly in use on a very large scale among stuff-dyers in the Bradford trade for the production of certain compound shades, especially so-called "sour browns," and for dyeing the cotton of mixed figured goods, producing, *e.g.*, a gold-coloured design on a scarlet or blue ground.

Archil, we are told, is prepared as follows:—"The lichens are first ground between two stones to a pulp, with the addition of water, and afterwards put into a wooden trough having a tightly-fitting cover; upon the moist pulp is sprinkled a mixture of urine and ammonia, and the vessel being then covered, fermentation soon begins. About six weeks are required to complete the operation." We do not desire to find any unnecessary fault; but we cannot help saying that such instructions are not of the slightest value.

The next section of the book consists of dyeing receipts, preceded by "preliminary preparations for dyeing." Some of these are curiously useless. No dyer, certainly, will waste his time in making copperas, or blue vitriol, since he can procure them from the drysalter at a much cheaper rate. Caustic soda is now also a regular article of commerce, and caustic potash has scarcely any applications in dye-works. Nitrate of iron is described in three several parts of the work (pp. 136, 198, and 342). But in all these passages it is spoken of as obtained by the action of nitric acid upon metallic iron. Now at least 9-10ths of the liquid used as nitrate of iron is more correctly a nitro-sulphate, and is made by treating copperas with proportions of nitric acid, varying greatly in different establishments. Nor is there any reference—as far as we have been able to discover—to the different qualities of nitrate of iron required for blacks, for royal blues, and for "saddening" compound colours.

Among the dyeing receipts for cottons, we find no mention of madder reds, nor, of any shades produced with artificial alizarine. To produce a scarlet upon woollens, we are told to "work for an hour in a bath, to which has been added 1lb. tartar, 2 ozs. dry cochineal, 8 ozs. sumach, 8 ozs. fustic." We never saw a cochineal scarlet produced in practice without the use of some preparation of tin; nor have we met with any other receipt in which this important requisite was omitted. The dyeing of mixed fabrics has not received a share of attention at all commensurate with its importance. There are three receipts for producing two colours on a piece, and five for dyeing the whole one colour. The author remarks that "the operator, by a careful study of the different modes of dyeing the different fabrics, may easily dye any mixed fabric one or more colours." We can assure him

that this problem, which he thinks so easy, occupied the attention of the stuff-dyers of Bradford for some 20 years, and involved numerous and costly failures before being brought to its present perfection.

At the end of the book we find a "glossary of technical terms used in the dye-house." Such a glossary, comprising the technical terms and trade names common in different districts, with their scientific equivalents, would be extremely valuable. But our author is not always fortunate in his explanations. Thus under "double muriate" we read "a saturated solution of *bichloride* of tin," and under "single muriate," "half strength of double *perchloride* of tin." It is, of course, well known that bichloride and perchloride of tin were till lately the authorised names for the bodies now known as stannic chloride, or tin tetrachloride. But if we turn to pp. 344 and 346, we find these mordants quite correctly described as being *proto* chloride of tin, now called stannous chloride or dichloride. Which of these two contradictory views is the reader, if inexperienced, to adopt?

That the work contains much valuable matter we gladly admit, and regret the more the presence of the defects and errors which we have been compelled to point out.

CORRESPONDENCE.

ADULTERATION OF BEER.

To the Editor of the Chemical News.

SIR,—As disputed cases of Public Analysts under the new Act will have to be referred to Somerset House, the result of the first reference of such a kind, so far as I am aware, may be interesting to some of your readers.

Some time ago, I gave a certificate of a beer being slightly adulterated by containing a small excess of common salt. The case was defended by the brewers (a Manchester firm). An adjournment was asked for, with the desire that the remaining portion of the sample should be submitted to Somerset House. This wish was complied with; the sample was despatched, and in due course the Somerset House authorities reported that it contained 58.20 grs. of salt per gallon, as against 59.05 grs., the amount given on my certificate—of course, to me, a very satisfactory result. The case has since been withdrawn, as explained by the enclosed cutting from the *Midland Counties Express* of the 14th inst. —I am, &c.,

E. W. T. JONES,
Public Analyst for South Staffordshire and
the Borough of Wolverhampton.

Public Analysts' Laboratory,
10, Victoria Street, Wolverhampton,
August 17, 1875.

"THE NEW ADULTERATION ACT.—Mr. Underhill brought under the notice of the learned Stipendiary (J. Spooner, Esq.) a case which was heard some weeks ago at Wednesbury, involving a charge against a publican named Shaw, living at Great Bridge, of selling adulterated ale. The certificate of the county analyst, he said, was to the effect that the ale contained nearly 59 grains of salt to the gallon; and the analyst at Somerset House, to whom a sample had been sent for inspection, gave practically the same figures as Mr. Jones. The brewers, who were really defending the case, were desirous of having the question judiciously settled as to whether a hard and fast line must be drawn at 50 grains to the gallon, but a new Act of Parliament affecting the point would come into operation on the 1st of October next, and any decision which was arrived at now might be altered at that time. He had, therefore, had a conversation with Mr. Horder, the inspector under the Adulteration Act, and suggested to him that the ends of justice would be met by the withdrawal of the case on the defendant paying all the costs.—Mr. Horder remarked

that under the circumstances he did not object to a withdrawal, as the defendant had been subjected to very heavy expenses.—The learned Stipendiary said the only reason why he hesitated at all in the matter was that he had convicted other persons for a no greater amount of adulteration. Considering the costs of the defendant, which had been further increased by an appearance at Wednesbury Police Court last week, when he (Mr. Spooner) was too ill to attend, and also looking at the fact that an Act of Parliament affecting the question, which he had not at present seen, would soon become law, he did not see the unfairness of allowing the case to be withdrawn.—Summons withdrawn accordingly."

MR. ALLEN "ON BUTTER."

To the Editor of the Chemical News.

SIR,—Mr. Allen's paper, published in the *CHEMICAL NEWS*, vol. xxxii., p. 77, is calculated to convey an incorrect impression as to the actual condition of butter analysis.

The difficulty of distinguishing between butter-fat and other fat of like melting-point has not yet been surmounted, and I am afraid that the so-called detections of that kind of adulteration must rank with the old-fashioned alum detection.—I am, &c.,

J. ALFRED WANKLYN.

Laboratory, 117, Charlotte Street, Fitzroy Square,
London, W., August 21, 1875.

THE DETECTION OF NICKEL AND COBALT.

To the Editor of the Chemical News.

SIR,—In the *CHEMICAL NEWS*, vol. xxxii., p. 71, Mr. A. P. Luff mentions his belief that in my paper on the above subject (vol. xxxii., p. 44) I have taken more credit than I am fairly entitled to.

As the paper in question contains what may be called two methods, as well as an additional test for the identification of nickel, Mr. Luff might have indicated more exactly to what extent, in his opinion, Messrs. Compton and Gostling were entitled to credit.

I have not heard of anyone using ferrocyanide for the detection of cobalt; I suppose, therefore, the method first detailed is that to which Mr. Luff more especially refers.

In this belief, I must trespass upon your valuable space in stating the facts of the case, as far as I remember them. And, first, I would observe that the phrase "as far as I remember them" is inserted because the occurrence took place some eighteen months ago, I suppose; and after this lapse of time it is difficult to speak with absolute certainty upon such a question. (Mr. Luff is in error when he says that either he or the two gentlemen he mentions studied in the laboratory of the Pharmaceutical Society *last session*. They all worked there during the session before last.)

In January or February, 1874, Mr. Compton showed me the red-coloured liquid he had accidentally obtained by adding ferricyanide of potassium to ammoniacal solution of a cobalt salt. I had not at that time seen the papers on the subject by Messrs. Skey and Allen, and thought that, in thus finding cobalt ferricyanide soluble in ammoniacal salt, he had made an original discovery. I went over the matter at his bench, and within an hour found that, by employing ferrocyanide and partially neutralising the solution, nickel might be identified when occurring either with or without cobalt.

Mr. Compton and Mr. Gostling have been asked by me what portion of the test each considers himself to have discovered. Mr. Compton replies that, as far as he recollects, the account given above is correct in its details. Mr. Gostling, on the other hand, writes as follows (letter received this morning):—"I am certain that the idea of using potassium *ferrocyanide* for nickel was mine; as to the gradual addition of an acid, I firmly believe that was mine also."

Mr. Gostling may have found out how to advantageously employ ferrocyanide for nickel; I have no reason for asserting that he did not. Indeed, it seems to me that any man with good common sense, understanding the significance of the statement that potassic ferricyanide reacted, under certain circumstances, in a marked manner with cobalt salts, would probably try what effect this reagent had upon nickel salts, and also what effect ferrocyanide had upon salts of both metals similarly circumstanced.

Mr. Gostling's opinion, I need hardly say, does not shake my belief (which Mr. Compton appears to share) that this essential feature of the method was discovered by me.—I am, &c.,

R. H. DAVIES.

Newport, Mon., August 21, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 5, August 2, 1875.

Magnets Formed with Compressed Powders.—M. J. Jamin.—De Haldat published in 1836, in the *Mémoires de l'Académie de Stanislas*, an interesting observation. He placed iron filings in a brass tube with screw stoppers; magnetised it by ordinary means, and found that it had acquired and preserved at its extremities two contrary poles. The polarity did not augment sensibly when the stoppers were tightened; it only diminished slowly when increasing quantities of sand were mixed with the filings. In all cases the polarity was feeble, and disappeared on shaking the tube. M. Jamin has repeated the observation, compressing the filings strongly by means of a small hydraulic press. The polarity increases with the pressure. Filings were prepared under the author's eyes from very soft iron, perfectly reduced, and free from coercitive force. The results did not diminish. Here, therefore, is a metal which has no coercitive force when it is continuous, but which acquires a force as considerable as that of steel if reduced to discontinuous fragments, and aggregated by pressure. Is it not to this discontinuity that the force observed must be ascribed, and is it not this same cause which explains the coercitive force of steel? If the filings before pressure are mixed with matters which render the mass more homogeneous, the same degree of polarity is no longer produced. For instance, on making a paste of chloride of iron and iron filings, and pressing it, we obtain after some days a subchloride of iron of continuous appearance, which may be filed and polished like pure iron, but which scarcely becomes magnetic.

Purchase of Beet-Root based upon the Density of the Juice.—M. Durin.—It has been shown that the quality of beet-root is in an inverse ratio to the bulk of the crop. The interests of the grower who expends azotised manures in order to obtain an abundant crop are opposed to those of the manufacturer who wishes to operate upon a rich article only. It is clear that as long as beets are bought by weight these opposite interests cannot be reconciled. It is therefore proposed to fix the value of the roots in accordance with the density of the juice.

Microzymas, and their Functions in Different Ages of the Same Animal.—M. J. Béchamp.—A valuable physiological paper.

New Procedure for the Determination of Free Oxygen in Urine.—M. D. Freire.—The author employs pyrogalllic acid dissolved in an excess of ammonia. Of this acid 0.002 grm. absorb 0.52 c.c. of oxygen. He makes a standard solution with this quantity of pyrogalllic acid

dissolved in an excess of ammonia, which is exposed for some time to the air in order to saturate it with oxygen. He then makes a solution of 1.4 grms. stannous chloride in 100 c.c. hydrochloric acid moderately concentrated, and fills a graduated burette with this liquid. It is allowed to flow drop by drop into that resulting from the contact of the pyrogalllic acid and ammonia until completely decolourised. The number of degrees of the burette required for this purpose corresponds to the real quantity of oxygen absorbed by 0.002 grm. of pyrogalllic acid. This done, he takes 50 c.c. of urine, adds 0.002 gr. of pyrogalllic acid, after dilution with distilled water recently boiled, so as to have a colourless liquid, and it is then covered with a layer of pure essence of turpentine, several centimetres in depth. An excess of ammonia is then added, letting it flow in along the side of the vessel. The liquid which was colourless becomes gradually violet or yellowish, a change due to the absorption of the small amount of oxygen. The (stannous) liquor is then added with the burette, drop by drop, until it is decolourised. The number of divisions necessary for decolourisation gives the amount of oxygen.

Molecular Combinations.—M. C. Friedel.—Reserved for insertion in full.

Complete Separation of Arsenic from Animal Matters, and on its Determination in Various Tissues.—M. Armand Gautier.—The author's method agrees very closely with that of Dr. Scolosuboff.

Determination of Glucose in Wine; a reply to a Reclamation by M. Chancel concerning the apparently Gummy Matter of Wine.*—M. A. Béchamp.—A controversial paper.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 13, July 29, 1875.

The editor gives in this number, under the curious heading *Chronique Philosophique*, seven pages of a denunciation of M. Littré on the occasion of his having become a Freemason. There is no chemical or physical matter.

M. Reimann's Farber Zeitung,
No. 27, 1875.

The shoemaker at Stettin, said to have been poisoned by the dye of the lining of his hat, is found to have been merely suffering in consequence of an excessive dose of alcohol. The hat lining contained nothing poisonous.

There are receipts for a lilac and black on calico; a marine blue on mixed garments; a black, a brown, and a bismarck for woollen printing; a mode grey and a fine orange for cotton yarns; and a black for horsehair.

No. 28, 1875.

This issue contains instructions for a black on horsehair; for a brown on mixed garments; a fast blue for woollen yarns and pieces, an olive for the same materials; and a cheap wood-red for wool. There are further receipts for a black (mill-fast) for cottons, and a corinth for cotton yarn.

No. 29, 1875.

This issue announces that in Lyon a kind of cloth is now prepared from the down of hens, ducks, &c. 750 grms. of feathers yield 1 square metre of a light and very warm fabric, which is waterproof, and admits of being dyed in all shades.

There are, further, receipts for brown and blacks on garments; for a fast and fugitive bismarck on woollen yarn and cloth, and for a mulberry.

No. 30, 1875.

This issue contains calculations made by the firm of Simonis in Vervier, from actual work, showing that the

* *Comptes Rendus des Séances de l'Académie des Sciences*, lxxxi., page 46.

direct saving effected by the hydrosulphite-vat of Schützenberger and de Lalande as compared with the old fermentation-vat is 2 per cent on the net profit.

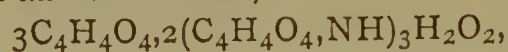
There are receipts for a light reseda on linen, a black on mixed garments, a rose on silk, and an iron-grey on silk yarns.

Bulletin de la Societe Chimique de Paris,
No. 3, August 5, 1875.

Distribution of an Acid among several Bases Existing in Solution.—M. Berthelot.—Already noticed.

Direct Union of Propylen with the Hydracids.—M. Berthelot.—The author recommends as a lecture experiment to fill two stoppered bottles, the one with pure dry propylen, and the other with hydriodic acid gas, to bring them quickly in conjunction, removing the stoppers, and connecting the necks with a broad band of caoutchouc.

Acetates of Ammonia.—M. Berthelot.—The author has obtained an acid acetate,—



crystallising in long, brilliant, flattened needles, by dissolving the acetate of ammonia of commerce in its own weight of glacial acetic acid.

MISCELLANEOUS.

University of London (First M.B. Examination).—*Examination for Honours.*—Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry. First class. Arthur Thomas Wilkinson (Exhibition and Gold Medal), Owens College School of Medicine; George Courtenay Henderson. (Gold Medal), University College. Second class. Francis Goodchild, St. George's Hospital. Third class. Richard Shalders Miller, University College.

NOTES AND QUERIES.

Action of Carbonic Acid on the Growth of Plants.—Dr. Daubeny made some experiments, I believe, on the growth of plants in an atmosphere containing more carbonic acid gas than air contains. I should be glad to be informed where I can find an account of these experiments, or what results were obtained.—C. O. Two.

TO CORRESPONDENTS.

J. De Baskerville.—We think you can purchase precipitated chalk more advantageously than you can make it. The best article is made by letting lime-water stand in a closed vessel till perfectly clear (to get rid of any suspended grit), and then running the clear liquid into an open vessel and passing into it carbonic acid gas, obtained by the action of dilute sulphuric acid upon ground limestone. The vessel must be covered with a cloth, to exclude dust, grit, &c.

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THE CHEMICAL NEWS.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRISTOL MEETING.

ADDRESS TO THE CHEMICAL SECTION

BY

A. G. VERNON HARCOURT, M.A., F.R.S., F.C.S.,
President of the Section.

To the privilege of presiding over this Section custom has added the duty of offering some preliminary remarks upon the branch of science for whose advancement we are met.

In discharge of this duty some of my predecessors have reviewed the progress of chemistry during the previous year; and until a few years ago there was no more needful service that your President could render, though the task of selection and abstraction was one of ever-increasing difficulty. But a few years ago the wisdom and energy of Dr. Williamson transformed the *Journal of the Chemical Society* into a complete record of chemical research, and this Association materially promoted the advancement of science when it helped the Chemical Society in an undertaking which seemed at one time hopelessly beyond its means. The excellent abstracts contributed to the *Journal* err, if at all, on the side of brevity, and yet the yearly volume seems to defy the bookbinder's press. I shall not venture to attempt further abstraction, nor to put before you in any way so vast and miscellaneous an aggregate of facts as the yearly increment of chemistry has become. The advancement of our science—to borrow again the well-chosen language of the founders of this Association—is of two kinds. The first consists in the discovery and co-ordination of new facts; the second in the diffusion of existing knowledge, and the creation of an interest in the objects and methods and results of scientific research. For the advance of science is not to be measured only by the annual growth of a scientific library, but by the living interest it excites and the number and ardour of its votaries. The remarks I have to offer you relate to the advancement of chemistry in both aspects.

One fact has been brought into unpleasant prominence by the *Journal of the Chemical Society* in its present form, namely, the small proportion of original work in Chemistry which is done in Great Britain. All who are ambitious that our country should bear a prominent part in contributing to the common stock of knowledge, and all who know the effect upon individual character and happiness of the habit and occupation of scientific inquiry, must regret our backwardness in this respect. The immediate cause is easily found. It is not that English workers are less inventive or industrious than their fellows across the Channel, but that their number is exceedingly small. How comes it that, in a country which abounds in rich and leisurely men and women—for neither the reason of the case, nor the jealousy of the dominant sex, nor partial legislation, excludes women from sharing this pursuit with men—there are so few who seek the excitement and delights of chemical inquiry. Moralists tell us that the reason why some men are content with the pleasures of eating and drinking and the like is, that they have never had experience of the greater pleasure which the exercise of the intelligence affords. I am not about to represent it as the moral duty of those who have means and leisure to cultivate chemistry or any branch of science; but no taste for a pursuit can be developed in the absence of any

knowledge of its nature. A taste for chemistry is often spoken of as a peculiar bias with which certain men are born. No doubt there are differences in natural aptitudes and tastes, but the chief reason why it is so rare for men of leisure to addict themselves to scientific pursuits is, that so few boys and young men have had experience of the pleasure which they bring. Much has been done during the last twenty years, both at the universities and at the public schools, to provide for the teaching of science. To speak of what I know best, the University of Oxford has made liberal provision for the teaching of science, and for its recognition among the studies requisite for a degree; nor have the several colleges been backward in allotting scholarships and fellowships as soon as and whenever they had reason to believe that those elected for proficiency in science would be men equal in intellectual calibre to those elected for proficiency in classics or mathematics. But the result is somewhat disappointing, and under a free-trade system science has failed to attract more than a small percentage of University students. Excellent lectures are delivered by the Professors to scanty audiences, and the great bulk of those educated at the University receive no more tincture of science than their predecessors did twenty ago.

The recognition of science among the subjects of University examinations is by no means an unmixed advantage to those concerned. Examinations have played and will continue to play a useful part in directing and stimulating study, and in securing the distribution of rewards according to merit; but they produce in the student, as has often been pointed out, a habit of looking to success in examination as the end of his studies. This habit of mind is peculiarly alien to the true spirit of scientific work. Only such knowledge is valued as is likely to be producible at the appointed time. Whether a theory is consistent or true is immaterial, provided it is *probable*, that is to say, advanced by some author whose authority an examiner would recognise. All incidental observations and experimental inquiry lying outside the regular laboratory course, which are the natural beginnings of original work, must be eschewed as trespassing on the time needed for preparation. The examination comes; the University career is at an end; and the student departs, perhaps with a considerable knowledge of scientific facts and theories, but without having experienced the pleasure, still so easily gained in our young science of chemistry, of adding one new fact to the pile of knowledge, and, it may be, with little more inclination to engage in such pursuit than have most of his contemporaries to continue the study of Aristotle or Livy.

However, examinations have their strong side, to which I have referred, as well as their weak side; and, although it is the natural desire of a teacher to see his more promising pupils contributing to the science with whose principles and methods they have laboured to become acquainted, the younger, like the elder branches of knowledge, must be content to serve as instruments for developing men's minds. Chemistry can only claim a place in general education if its study serves, not to make men chemists, but to help in making them intelligent and well informed. If it is found to serve this purpose well, the number of chemical students ought to increase; and if the number increases, no rigour of the examination system will prevent one or two, perhaps, in every year adopting chemistry as the pursuit of their lives. But the Universities have little power to determine what number of students shall follow any particular line of study. With certain reserves in favour of classics and mathematics, their system is that of free-trade. Young men of eighteen or nineteen have tastes already formed, some for the studies which were put before them at school, in which, perhaps, they are already proficient and have been already successful, some for games and good-fellowship. It is from the nature of the case with the masters of schools that the responsibility rests of fixing the position of science in education. During the last ten years provision has been made at most of the larger schools for the teaching of some branches of science;

and those who recall the conservatism of schoolboys, and their consequent prejudice in favour of the older studies, will understand a part of the difficulties which have had to be encountered. The main and insurmountable difficulty is what I may call the impenetrability of studies. A new subject cannot be brought in without displacing in part those to which the school-hours have been allotted. It is the same difficulty which occurs again and again in human life. There are so many things which it would be well to know and well to follow; but life, like school-time, is too short for all. From the educational phase of this difficulty the natural differences of tastes and aptitudes provide in some degree a way of escape. I think that, wherever a school can afford appliances for the teaching of chemistry, all the boys should pass through the hands of the teacher of this subject. Two or three hours a week during one school-year would be sufficient to enable the teacher to judge what pupils were most promising. There may be instances to the contrary, but I do not think it likely that any boy who attended chemical lectures for a year without becoming interested in the subject would ever pursue it afterwards with success. Suppose that, out of one hundred boys who have gone through this course, five are selected as having shown more intelligence or interest than the rest; they should be permitted to give a considerable part of their time, while still at school, to studying science without suffering loss of position in the school, or forfeiting the chance of scholarship or prizes. If any such system is possible, and were generally adopted, each school sending annually to the Universities, or other institutions for the education of young men, its small contribution of scientific students, the Professor's lecture-rooms and laboratories would be filled with young men who had already learnt the rudiments of science. Laboratories of research as well as of elementary instruction would find a place at the English Universities, and the reproach of barrenness would be rolled away.

Some of the defects or difficulties to which I have adverted are perhaps peculiar to our older schools and universities. The introduction of the study of natural science has borne earlier fruit in schools whose celebrity is of more recent date, such as the excellent College in this neighbourhood. Oxford and Cambridge ought to possess, but are far from possessing, such laboratories as have lately been built at the Owens College, Manchester. It is proposed to constitute in this city a College of Science and Literature, similar to Owens College and in connection with two of the Oxford Colleges. The scheme set forth by its promoters appears thoroughly wise and well considered, and all who are interested in scientific education must wish it success.

I have placed first among the modes in which science—and in particular chemical science—may be advanced the assignment to it of a more prominent and honoured place in education; but owing, as I do, my scientific calling and opportunities of work to a bequest made to Christ Church by Dr. Matthew Lee more than one hundred years ago, I cannot forget or disbelieve in the influence of endowments.

I have spoken of the leisurely class in this country as that to which scientific Chemistry must look for its votaries. In our social conditions, and in the absence of endowments, it is hard to see where else they can be found. Men who have their livelihood to make cannot afford to spend money, and still less to bestow their time and energy on the luxury of scientific inquiry. Even if they have the opportunity of earning their livelihood by scientific teaching no leisure may remain to them for original work, and the impulse to such work (often, it must be admitted, of a feeble constitution) is starved in the midst of plenty. The application of endowments to the promotion of original research is a difficult question. I am inclined to think that posts, constituted chiefly with this object, should be attached in every case to some educational body, and should have light educational duties assigned to them. The multiplication of such posts in connection with the many colleges and schools in this country, where there is

some small demand for chemical teaching, with the provision in each case of a sufficient laboratory and means of work, would probably do more than any centralised scheme for the promotion of chemical research.

To the advancement of chemistry by the formation of public opinion on the questions of scientific education and the endowment of original research, the Chemical Section of the British Association may reasonably hope to contribute. But doubts have been expressed as to the serviceableness of this or any such organisation for the direct advancement of our science itself. No doubt we cannot accomplish much. Chemical inquirers at the present time may be compared to a party of children picking wild flowers in a large field; at first all were near together, but as they advanced they separated, till now they are widely scattered, singly, or in groups, each busy upon some little spot, while for every flower that is gathered ten thousand others remain untouched.

That the science of chemistry would advance more rapidly if it were possible to organise chemists into working parties, having each a definite region to explore, cannot, I think, be doubted. Is such organisation in any degree possible?

The experiments of which Bacon has left a record, though curious historically, have no scientific value. But in one respect his "Physiological Remains" furnish an example which we might follow with profit. "Furthermore," he writes, "we propose *wishes* of such things as are hitherto only desired and not had, together with those things which border on them, for the exciting the industry of man's mind." I will quote further, as an example, a part of one of his wishes, which has very recently been fulfilled. "Upon glass four things would be put in proof. The first, means to make the glass more crystalline. The second, to make it more strong for falls and for fire, though it come not to the degree to be malleable."

I do not know that the industry of M. de la Bastie's mind was excited by Bacon's enumeration of glass more strong for falls and for fire among things hitherto only desired and not had; but the conception of such an enumeration seems to me worthy of its author. Much fruitless and discouraging labour might be saved, a stimulus might be given to experimental inquiry, and chemical research might become more systematic, and thus more productive, if Bacon's example were followed by the leaders of chemistry at the present day.

The Council of the Pharmaceutical Conference, whose meeting has just preceded our own, has published a list of subjects for research which they commend to the attention of chemists. Where one of these subjects has been undertaken by any chemist his name is appended to it. Might not the representatives of scientific chemistry issue a similar list?

Perhaps two or three of the distinguished English chemists who are members of this Association, might be willing to serve on a committee, which should put itself into communication with the leaders of chemical inquiry abroad, and should make and obtain and publish suggestions of subjects for research. Such a list so got together would, I think, find a welcome place in all scientific journals, and would thus be widely known and easily accessible to every student.

That which chiefly makes the organisation of chemical inquiry desirable is the boundless extent of the field upon which we have entered. Not every fact, however, laboriously attained and rigorously proved, is an important fact in chemistry any more than in other branches of knowledge. Our aim is to discover the laws which govern the transformations of matter, and we are occupied in amassing a vast collection of receipts for the preparation of different substances and facts, as to their composition and properties, which may be of no more service to the generalisations of the science, whenever our Newton arises, than were, I conceive, the bulk of the stars to the conception of gravitation.

It may, however, be urged that the growth of chemical theory keeps pace with the accumulation of chemical facts. It is so, if the elaboration of constitutional formulæ is leading us up to such a theory. But at present, however useful and ingenious this mode of summarising chemical facts may be, it does not amount to a theory of chemistry.

Two objections to regarding such formulæ as anything more than a chemical shorthand, as it has been termed, seem worth recalling. The first is mentioned at the outset in most text-books in which these formulæ are employed, but sometimes, I venture to think, lost sight of afterwards. The arrangement of the atoms of a molecule in one plane is equally convenient in diagrams, and improbable as a natural fact. But is not this arrangement used as though it were a natural fact when the possible number of isomeric bodies is inferred from the number of different groupings of the atoms which can be effected on a plane surface? The conceptions of plane geometry are much simpler than those of solid geometry (which is another recommendation of the present system of formulæ); but so far as I am able to follow the similar theories which have recently been propounded independently by MM. De Bel and Van't Hoff, the consideration of the possible immersions of *solid* molecules leads to new conclusions. Wislicenus has found that paralactic acid undergoes the same transformations as ordinary lactic acid when heated and when oxidised. The two acids differ in their action on polarised light. His conclusion is that paralactic acid does not differ in its atomic structure from the lactic acid of fermentation, and that the kind of isomerism which exists between the two acids is not connected with the difference in the reciprocal arrangement of the atoms, but rather with a difference in the geometric structure of the molecule. To this difference he gives the name of "geometric isomerism." The authors named above agree in supposing that the action of substances in solution on polarised light results from an unsymmetrical arrangement of atoms and radicles in three dimensions around a nucleus atom of carbon.

The second objection relates to the statical character of the account which "developed" formulæ give of the differences between different kinds of matter. The modern theory of heat supposes, not only that the molecules which constitute any portion of matter are in constant rapid motion, but that the atoms which constitute each molecule are similarly moving to and fro. Such movement might be an oscillation about the position assigned to the several atoms in the constitutional formulæ of the molecule. Since, however, the modes of formation and decomposition of substances are the only facts upon which the formulæ are based, it is to be considered whether these facts may not depend altogether upon the nature or average nature of the motion impressed upon the atoms,—that is, upon dynamical and not upon statical differences.

Many substances are known whose existence is contrary to the theory of valency and saturation, such as nitric oxide and carbonic oxide; others, which transgress the theory of isomerism, such as chloride of dichloridibromethane ($C_2Cl_2Br_2, Cl_2$) and bromide of tetrachlorethane (C_2Cl_4, Br_2), which should be identical, but are isomeric; yet these theories are simply an expression of the statement that certain substances can exist or can differ, while others cannot. It is true that in the vast majority of cases the theoretical limitation appears to exist. But just as the absence of any fossil remains of the connecting links between species is only significant if the geologic search has been sufficiently thorough, so it is with chemical theories depending upon the non-existence of certain classes of bodies. Indeed, in our case, where investigation is guided by theory, and, as a rule, only those things which are looked for are found, the limitation may be partly of our own making. A chemist who should depart from the general course, and set him-

self to prepare substances whose existence is not indicated by theory, would perhaps obtain results of more than the usual interest.

Among chemical inquiries, if ever such a list as I have ventured to suggest should be drawn out, I hope that many would be included relating to the most peculiar substances and the simplest cases of chemical change. The thorough study of a few reactions might perhaps bring in more knowledge of the laws of chemistry than the preparation of many new substances.

I believe that if any chemist not content with a process giving a good yield of some product examines minutely the nature of the reaction, observing its course as well as its final result, he will find much more for study than the chemical equation represents. He will probably also find that the reaction and its conditions are of a formidable complexity, and will be driven back towards the beginnings of chemistry for cases sufficiently simple for profitable study.

In concluding my remarks, I desire briefly to refer to another branch of chemical science to the advancement of which this Association seeks to contribute—I mean applied or technical chemistry. One of the principal differences between the papers read before this Section, as a class, and those which the Chemical Society receives, is the larger proportion in our list of papers on technical subjects. Whatever chemists may hold, there can be no doubt that the estimation of our science by the outside world rests largely on the well-founded belief that chemistry is useful. Indeed, though scientific chemists are justly eager to vindicate the value of investigations remote from any application to the arts, they cannot but feel a livelier sense of triumph when the successful synthesis of a vegetable principle yields also a product of great technical value in the arts, as in the case of the production of artificial alizarin.

By visiting in turn the principal centres of British industry, this Association brings together men engaged on pure and on applied chemistry. We who come as visitors may hope that our papers and discussions here may bring fresh interest in the science, if not actual hints for practice, to those whose art or manufacture is based on chemistry. In return, the most interesting communications the Section has received have not unfrequently been the descriptions of local industries; and there is no part of our hospitable reception more welcome and more instructive to us than the opportunities which are provided of seeing chemical transformations on a large scale, and effected by processes which observation and inventiveness have gradually brought to perfection, and with the surprising familiarity and skill which are engendered by daily use.

ON MOLECULAR COMBINATIONS.

By M. C. FRIEDEL.

IN a recent communication, I had the honour of calling the attention of the Academy to a compound of methylic oxide and of hydrochloric acid.* The properties of this compound appear to me particularly interesting, because it is one of that numerous class of compounds known as molecular. M. Kekulé has thus designated those which do not obey the generally admitted laws of atomicity. Formed by the union of two or more complete molecules capable of existing separately, they seem still to contain these molecules *as such*. They are instable and easily split up, especially under the influence of heat. Their non-existence in the state of vapour has been pointed out as their true characteristic. The facts which I have brought forward prove that this character is not absolute, and that there exist molecular compounds which may be vapourised without total decomposition. There is, then, no well-marked limit between atomic compounds and molecular compounds;

* CHEMICAL NEWS, vol. xxxii., p. 83.

the one and the other may be re-united under one, and the same general law of combination. It would be illogical to ascribe the former to a cause residing in atoms, and the latter to a different cause inherent in molecules. The ultimate particles, whose existence the atomic hypothesis admits, should contain in themselves, as form or as motion, that which gives rise to all the phenomena produced by the aggregation of atoms, similar or dissimilar.

For chemists who, like M. Kekulé, admit for each element an absolute and invariable atomicity, there is here a difficulty which appears insurmountable, and which might make us forget the services rendered to the systematisation of chemical combinations by the consideration of atomicity. But if we, with Couper and Würtz, regard atomicity, *i.e.*, the capacity of saturation of the atoms, as varying at once with temperature and with the nature of the atoms brought in presence, the difficulty disappears. It becomes natural to ascribe the formation of the so-called molecular compounds to the existence, in certain elements, of supplementary atomicities, which only act at low temperatures. It may be difficult to determine these supplementary atomicities in a manner which shall not be arbitrary, but, by bestowing upon the study of molecular combinations, the same attention which has been hitherto given to atomic compounds, and by taking advantage of the analogies existing between the divers members of one and the same family, there is room to hope for ultimate success.

As to the compound which has been the starting-point of these investigations, C_2H_6O, HCl , it results that we may, without too great risk, ascribe its formation to two supplementary atomicities of oxygen, and, perhaps, at the same time, to two supplementary atomicities of chlorine. We know already bodies which oblige us to admit that oxygen sometimes acts as a tetratomic element; these are the quadrantoxides of H. Rose (Ag_4O, Cu_2O). We find another reason in the comparison of the hydrochlorate of methylic oxide with the interesting compound discovered by M. Cahours, obtained by the action of methylic iodide upon methylic sulphide. In this body, relatively stable (although decomposed if we attempt to convert it into vapour) and susceptible of double decomposition, the sulphur acts evidently tetratomically. It forms the link between the two molecules of sulphide of methyl and of iodide. Analogy leads us to believe that oxygen plays a like part in the combination of methylic oxide and hydrochloric acid. A negative experiment which I have made seems also to support this supposition. If we pass into a vessel cooled down to -18° to -20° a mixture of methylic chloride and hydrochloric acid, no liquid is condensed. Nor is there any contraction if we mix over mercury known volumes of hydrochloric acid and of methylic chloride. The sole difference between these experiments and those which gave rise to the compound in question is the presence of oxygen in the latter in place of chlorine.

The same supposition may explain, in a great many cases in a simple manner, the fixation of water of crystallisation upon salts and the formation of certain double salts; but here the hypothesis complicates itself, and becomes less capable of verification. We must interpose here the atomicities of the second order of numerous elements, and this can only be done in a useful manner after a long comparative investigation.

I may be permitted, in conclusion, to reply to an objection which has already been made to the theory of variable atomicity, and which will, doubtless, be more frequently raised, on account of the extension which I propose to give it. Not to admit for elements an atomicity as invariable as the atomic weight is, they say, to complicate the theory and to deprive it of its rigour. It seems to me that a theory loses more by leaving on one side the explanation of a considerable number of facts, than by accommodating itself so as to link them all to one principle. The principle is here the capacity of saturation of atoms, varying between limits more or less narrow; but

such, nevertheless, that a small number of types of simple combinations enable us to comprehend the indefinite number of known bodies.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 93.)

ONLY the highest branch of industry, that in which justly no price is considered too high, as its object is health, to wit medicine has found the present methods sufficient to allow of the application of ozone. These endeavours were founded on the same observation first published by Schönbein, and subsequently placed beyond the reach of doubt by Andrews† that the air of towns, and even that of well-ventilated rooms in the country contains no ozone, whilst it can always be discovered in the open-air of the country, and the certainly unproved conjecture of Schönbein as to the connection between epidemics and a deficiency of ozone.

Latterly Lënder has come forward as the advocate of the medical application and efficacy of ozone, which he recommends both as ozonised air and ozonised water in tuberculosis, rheumatism of the joints, glaucoma, asthma, gout, &c.‡ That his exertions have not met with the approval of the profession appears from a discussion of the Berlin Medical Society, Oct. 29, 1873, held under the presidency of Dr. Von Langenbeck. Here the use of ozone was defended by Lënder alone, and met with zealous opposition. O. Leibreich argued on this occasion that it was impossible to convey into the blood a body so unstable as ozone, which must be decomposed in the respiratory organs. Inhalations of ozone must, therefore, be merely inhalations of pure oxygen, whilst the disinfection of sick chambers may be effected by simpler and better means. Nevertheless, it is necessary to mention here the observations of Schöne§ and Houzeau¶ that after working with ozone, its peculiar odour adheres to the hands for some time, as well as to garments of flannel or other tissues. Its decomposition therefore appears not to be instantaneous. That the physiological action of strongly ozonised oxygen is very important, appears from the recent experiments of Dewar and MacKendrick.** Oxygen ozonised by induction, and containing at most 10 per cent. of ozone, killed small animals which were allowed to inhale it, such as rabbits, mice, and small birds, the two latter in 20 minutes. Respiration was rendered slower, the pulse was enfeebled, and the blood in all parts of the body was rendered venous. This remarkable phenomenon is considered by the observers as due to the high specific gravity of ozone (24), which exceeds that of carbonic acid (22), and thus retards the diffusion of the latter out of the blood. The irritant action of ozone upon the mucous membrane and its destructive effect upon tissues are recognised both by these observers and by earlier authorities. Redfern considered in 1857 that in his experiments oxygen containing 1·240th of ozone proved fatal to small animals in 30 seconds, producing congestion and emphysema of the lungs after enlargement of the right ventricle.††

Lënder has established an ozone manufactory for medicinal purposes. It is announced that ozone inhalations

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Andrews, *Nature*, 1874, p. 366.

‡ Lënder, *Goschen's Deutsche Klinik*, 1872, 1873.

§ *Klinische Wochenschrift*, 1873, 588, 589.

¶ Schöne, *Berl. Chem. Ges.*, 1873, 1226.

¶ Houzeau, *Ann. Chim. Phys.* (4), xxvii., 16.

** Dewar and MacKendrick, *R. Soc. Edinb. Proc.* Session 1873-1874.

†† Andrews, *Nature*, 1874, 366.

may be had at about 74d. per cubic foot, or £1 per cubic metre. The method of preparation, and the strength in ozone, are not stated. Ozonised water, according to the degree of concentration, costs from 6d. to 1s. per bottle. This ozonised water was very carefully tested by Carius* with the unfavourable result that in 1000 grms., 0.0087 to 0.0095 grm., or less than 1-1000th per cent. of ozone, was present. Chlorine and hypochlorous acid were not detected. On the other hand, Behrens and Jacobsen† say that nothing but hypochlorous acid is found in commercial ozone-water. According to the experiments of Carius, the absorption coefficient of ozone in water is so small that the above-mentioned figures border very closely upon the highest possible quantity.

SOCIETY OF PUBLIC ANALYSTS.

"THE SALE OF FOOD AND DRUGS ACT 1875."†

By G. W. WIGNER and J. H. SCOTT.

THE object of this paper is to point out the chief points of difference between the "Adulteration of Food Act, 1872," and the "Sale of Food and Drugs Act, 1875," and to indicate the more salient features of the latter measure. The intention of the writers is not to dogmatise but to suggest, and while disclaiming any pretension to interpret in a strictly legal sense the Act of Parliament, they venture to hope that an intimate acquaintance with the Bill in all its stages, and an almost daily consideration of its clauses during its progress through Parliament, with the corresponding clauses in the Bill it is intended to supersede, may enable them to render into familiar language the leading provisions of the Act, more especially those which are likely to affect Public Analysts.

As the Act of 1872 contains only 12 clauses, and that of this year 36, it is impossible to compare the two Acts, clause against clause, but it is proposed to consider *seriatim* the provisions of the two Bills. It will be understood that, except where occasion appears to demand it, the verbiage of the clauses will not be quoted, but only their manifest intent given. The preamble of the Act of 1872 states that its object is the repression by more effectual laws of "the practice of adulterating articles of food and drink and drugs."

The Act of 1875 simply recites that "it is desirable that the Acts now in force be repealed, and that the law regarding the sale of food and drugs in a pure and genuine condition should be amended."

The first law is avowedly to put down the adulteration of food, and yet it contains no definition either of what is meant by "adulteration" nor what is to be understood by "food." In the new Act the word "adulteration" is studiously and intentionally dispensed with, the Government confessing their inability either to frame a satisfactory one or to accept the one which, after much deliberation, the "Society of Public Analysts" had drawn up, but it does contain a clear and comprehensive definition of what is to be understood by food and drugs, namely:—"The term 'food' shall include every article used for food or drink by man, other than drugs or water: the term 'drug' shall include medicine for internal or external use." The fact that water is not to be considered "food" is important to Public Analysts, as it will ensure that for water analysis proper fees can be charged. Clause 1 in the expiring Act and clause 3 in the new one treat of substantially the same offence, and subject the offender to a like penalty, but the phraseology of the later measure appears very much preferable.

According to the former Bill it must be proved that the offender has "wilfully admixed" the article sold with

some foreign substance which must of itself be "injurious to health." In the latter the words "knowingly" (which at first appeared) and "wilfully" are designedly avoided, it being, as is well known, next to impossible to produce proof of such knowledge, and instead of the adulterant being itself described as "injurious to health" its use is only forbidden if it render the article adulterated "injurious to health."

In the clause referred to, in the older Act, drugs are placed in exactly the same category as food, and it must also be noted that this clause refers only to the offence of *adulterating*, the punishment for *selling an adulterated article* being a lighter one provided for in a subsequent section, whereas in the Act of 1875 the punishment is the same for the person selling the debased article as for the person debasing it. In the new Act a wise distinction in the description of the offence as it regards food and drugs is drawn, in the former case it being described as "rendering the article (of food) injurious to health," and in the latter (drugs) of adding anything "to affect injuriously the quality or potency of the drug."

As the penalty alike for injuriously tampering with the goods and for selling goods so tampered with is £50 for the first offence, and six months' imprisonment for subsequent offences, and as no proof of knowledge is required in order to ensure a conviction, it will be obvious that but for some qualification this clause would in certain cases bear very hardly on tradesmen guilty of no more heinous offence than that of not being experts. It is, therefore, "provided that no person shall be liable to be convicted under either of the two last foregoing sections of this Act in respect of the sale of any article of food, or of any drug, if he shows to the satisfaction of the justice or court before whom he is charged that he did not know of the article of food or drug sold by him being so mixed, coloured, stained, or powdered as in either of those sections mentioned, and that he could not with reasonable diligence have obtained that knowledge."

This will give a tradesman who has bought honestly an impure article an opportunity of proving his innocence and shifting the blame on to the right shoulders.

The difference in effect between the corresponding clauses in the two Bills is that under the former one no conviction could be secured unless the prosecution could prove that the defendant had "wilfully" admixed, &c., while under the latter the proof that the forbidden admixture is present is sufficient, unless the defendant can show to the satisfaction of the Justices that, not only did he not know of the impurity, but that "he could not with reasonable diligence have obtained that knowledge." The increased effectiveness of the law as it is altered cannot fail to be appreciated.

In clause 2 of the old Bill a penalty of £20 is imposed for selling an article with which, *to the knowledge of the seller*, any ingredient injurious to health is mixed; but, as this knowledge must be proved, it is manifest that, so far, it must be even more inoperative than clause 1.

It is, however, provided, in the same clause, that "every person who shall sell as unadulterated an article which is adulterated" shall be fined; and, as this is without the qualification of "knowingly," it is only under this section that convictions have been obtained, except in rare instances where the Act has been imperfectly understood and loosely administered.

In clause 3 of the 1872 Act, selling articles that have been mixed with other substances for the purpose of increasing weight or bulk is forbidden; but as this, too, must be proved to have been done "knowingly," the same difficulty as has been already mentioned exists. In clause 2, just referred to, the offence is "selling as unadulterated an article that is adulterated," and, in the absence of any definition of "adulteration," a wide margin is left for differences of opinion as to what was and what was not adulteration.

The corresponding clause (6) in the new Act now reads—

* Carius, *Ber. Chem. Ges.*, v., 520, and vi., 806.

† Behrens and Jacobsen, *Vierteljahrsschrift f. Pr. Pharm. von Wittstein*, xxii., 230, 1873.

‡ Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

"No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds;" but is qualified by certain exceptions which deserve careful consideration, and which are "provided that an offence shall not be deemed to be committed under this section in the following cases; that is to say,"—

- "(1). Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof;
- "(2). Where the drug or food is a proprietary medicine, or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;
- "(3). Where the food or drug is compounded as in this Act mentioned;
- "(4). Where the food or drug is unavoidably mixed with some extraneous matter in the process of collection or preparation."

It cannot be denied that, under the first and fourth of these exceptions, articles may be sold which are not chemically pure, but yet, read by the light of common sense, it does not appear that miscarriages of justice are likely to be frequent. Exceptions 2 and 3 will be admitted to be not only unobjectionable but absolutely necessary.

It is very important to notice that, by clause 24 (which appears to be out of its proper place), if any defendant intends to rely upon any of these exceptions for his defence, he must *prove* that the mixture is justified by the exception. The incidence of the onus of proof in this case is of the utmost importance.

In the Bill of 1872 the Pharmacy Act of 1868 was incorporated. In the present measure it is not, and the provisions as to drugs are of the simplest character, viz.:—

- (1). The "quality or potency" of the drug shall not be injuriously affected (clause 4).
- (2). Proprietary or patent medicines may be sold (clause 6).
- (3). Compounded drugs (as well as compound articles of food) shall be compounded in accordance with the demand of the purchaser (clause 7).

In the last-named clause, it was proposed by the House of Commons to introduce certain stipulations as to drugs being in accordance with the British Pharmacopœia or with sundry other authorities, but it is quite a question whether, practically, the whole ground is not covered by the simpler method at last decided on.

Clause 8 refers to mixed drugs, and qualifies clause 7 to the extent that no offence shall be deemed to have been committed if the following conditions, which it is necessary to observe are conjunctive, not alternative, are observed:—

- (1). The mixture must be declared by a "distinct and legible" label.
- (2). The added matter must not be "injurious to health."
- (3). The admixture must not be intended fraudulently to increase the bulk, weight, or measure, or to conceal the inferior quality of the drug.

It may be open to argument, What loopholes for the sale of impure or deleterious drugs may be possible under these exceptions? but it does not seem likely that, if they are interpreted fairly, there can be much room for adulteration.

Clause 9 has no analogue in the old Act. It may be termed the "abstraction" clause, and makes it punishable to reduce the quality of any article by the abstraction of any part of it "so as to affect injuriously its quality, substance, or nature."

This will be admitted, by even the most adverse critics of the Bill, to be a step in the right direction, and it will specially recommend itself to those Analysts who have had to deal with the hitherto unpunishable but injurious custom of selling skimmed milk without so declaring it.

Clause 5 in the old and clause 10 in the new Act alike relate to the appointing bodies, which remain substantially the same.

Under both Acts the appointments are optional to this extent: that the bodies specified may appoint Analysts, and, when requested by the Local Government Board, *shall* do so; and in the new Act it is further ordered that, whenever an appointment has already been made, and the same becomes vacant, the vacancy *shall* be filled up.

The chief novelty in this clause is the provision that any person directly or indirectly connected with the sale of food or drugs shall be ineligible for the office of Public Analyst "for such place." This is, however, of course, not retrospective, and will not, therefore, affect any appointments already made.

Clause 11 gives power to any Town Council, &c., to appoint the Analyst for any neighbouring borough or county to act for their district "during such time as the said appointing body shall think fit," they making due provision for the payment of the Analyst's remuneration.

Clause 12 enacts that, where an Analyst is appointed, "any purchaser" shall be entitled, on payment of a fee not exceeding 10s. 6d., to have any article analysed; but it must be noted, in contradistinction to a somewhat similar provision in clause 9 of the Act of 1872, that the article must be taken direct to the Analyst and the fee paid to him, instead of both sample and fee being handed to the inspector. This alteration is very unacceptable to some Analysts, who fear they will be flooded with private samples at low fees; but an enquiry into the number of samples which have hitherto been taken to the inspectors will show that such a fear is exaggerated, if not groundless.

This clause also provides that, if there be no Analyst for the district, the purchaser may take his sample "to the Analyst of another place," but in such case the fee paid shall be "such as may be agreed upon between such person and the Analyst."

Clause 6 in the 1872 Act, and clause 13 in the Act of this year, referring to the purchase of samples by inspectors, are substantially the same. They are both open to the objection that they provide only for the analysis of "suspected" articles, and though, *theoretically*, they might lead to the utter break down of the Act, if the inspectors were allowed to purchase samples with public money and then resolutely refuse to "suspect" them, yet, practically, it may safely be left to the appointing bodies to take care that whatever samples are purchased for the purpose of analysis *shall* be analysed.

This clause also makes the important provision that, if any district chooses to appoint an inspector, but not an Analyst, the former may take any samples to the Analyst of another place, who shall analyse them on terms to be agreed upon between them. This will enable the authorities of any small place to have a number of analyses performed experimentally before making a permanent appointment.

It will also be noted that Medical Officers of Health are competent to act as inspectors, and cases may easily be imagined where their power to do so may be productive of much good.

The next point to be considered is the plan prescribed for the taking of samples by the inspectors. The directions in the Act of 1872 are very scanty.

Clause 6 says that the inspector shall procure and submit samples to be analysed by the Analyst; and clause 10 directs that such samples shall be divided and sealed "in the presence of the Analysts by the inspectors," the latter to retain a portion of each sample in case a further analysis should be ordered. It will be necessary to read clauses 14 and 15 of the new Act. They are:—

"14. The person purchasing any article with the inten-

tion of submitting the same to analysis shall, after the purchase shall have been completed, forthwith notify to the seller or his agent selling the article his intention to have the same analysed by the Public Analyst, and shall offer to divide the article into three parts to be then and there separated, and each part to be marked and sealed or fastened up in such manner as its nature will permit, and shall, if required to do so, proceed accordingly, and shall deliver one of the parts to the seller or his agent.

"He shall afterwards retain one of the said parts for future comparison and submit the third part, if he deems it right to have the article analysed, to the analyst.

"15. If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the Analyst receiving the article for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter."

It will thus be seen that the inspector, on purchasing a sample, is bound (unless the vendor waives his right) to divide it into three parts there and then, to seal up each portion, hand one to the vendor, take one to his own house, and submit the third one only to the Analyst.

From an Analyst's point of view the objections to this plan are very great, as two-thirds of every sample purchased he will never see at all, and if his analysis be disputed, and a second analysis, made on the inspector's or dealer's portion, contradicts his results, he will be more likely even than at present (and with better reason) to doubt if the separate portions have really formed part of the same sample.

Inspectors, too, are not usually so expert at tying up parcels securely as are shopkeepers, and if the parcel is only clumsily secured the difficulty would not be great, and the temptation to a vendor who knew he had sold an impure article would be considerable, to substitute another sample of different quality.

But, beyond this, there is the *possibility* of such a thing as collusion between an inspector and a shopkeeper, in which case the reputation of the Analyst would be in considerable peril.

Most strenuous efforts were made to obtain a modification of this clause during the time the Bill was before Parliament, but without success. The feeling outside the chemical circle was universal that a dealer had a fair right to have a portion of any sample upon which he might be prosecuted left in his own custody, for the purpose of having an independent analysis made, and this is not a claim to be easily gainsaid.

It was then urged on the Government that, if the inspector leave one-third of the sample with the vendor, he should take the other two-thirds *intact* to the Analyst, to be there divided, but this very reasonable proposal was not accepted.

Perhaps the Analyst might adopt one safeguard by insisting that the quantity of the article should be sufficiently large to insure that a third part of it would, after his analysis was made, still leave him enough for any further analysis which he might wish, in his own defence, to have made.

It will be seen that, by clause 15, if the dealer does not wish to have the article divided, it will be taken, as now, to the Analyst entire, and will be divided by him, he handing one part back to the inspector, either when he receives it or when sending his certificate.

Clause 16 makes it legal to send samples by post, and this provision, which may be convenient in some cases, has been the cause, to a very great extent, of the objectionable feature in clause 14.

Clause 17 provides that, if a vendor refuses to supply an inspector with any article "exposed for sale," or "on sale by retail," upon the price being tendered for it, he shall be liable to a penalty of £10. This regulation meets a diffi-

culty that has been constantly occurring under the old Act, where, the inspectors being known to the dealers, the latter have often absolutely refused to serve them.

It has been urged that the penalty imposed for the offence is too small, and that some vendors would prefer to pay £10 rather than have the impurity of their goods exposed.

It must not, however, be forgotten that, if a man were convicted of refusing to serve an inspector, such conviction would hardly do him less injury with his customers than a conviction for adulteration. Moreover, if he looked upon the fine of £10 as only a trifle, it would be open to the inspector to pay him a visit daily, and for each refusal to prosecute him.

Clause 7 of the 1872 Bill enacts that Analysts shall report quarterly to their appointing bodies, and that their reports shall be *read* at the meetings of the local authorities.

In clause 19 of the 1875 Act, the word "presented" is substituted for "read," but it is further ordered that the appointing bodies shall transmit annually to the Local Government Board a certified copy of each quarterly report of the Analyst. In clause 9 of the older Act, it is laid down that "in the absence of any evidence before the Court to the contrary, the Analyst's certificate shall be sufficient evidence of the matters therein certified."

This is substantially repeated in clause 21 of the 1875 Act, but is followed by the words "unless the defendant shall require that the Analyst shall be called as a witness." For such attendance the Analyst of course should be paid, and, though the Act itself is silent on the point, the opinion of the Local Government Board is distinctly to that effect. This clause also provides that the defendant and his wife may tender themselves as witnesses.

Clause 22, which provides that, at the discretion of the Justices, reference analyses shall be performed by the Somerset House officials, has been throughout strongly (though unsuccessfully) resisted by the Analysts, not because they are afraid of having their work checked by chemists of equal standing and experience with themselves, but because the standing and experience of the Inland Revenue chemists is altogether unknown. However, the clause stands, and it is to be hoped that, before the Somerset House laboratory has any food samples submitted to it, care will be taken that their staff is strong enough for the work. If this is not found to be so, it will behove Analysts who are satisfied of their own correctness (and all *should* be so) to take such precautions as will enable them to vindicate their results, even if they should be contradicted by Somerset House.

Clause 25 provides for the acquittal of a defendant if he can prove, to the satisfaction of the Justices, that he had purchased the article as the same the purchaser demanded of him, believed it to be the same, and held a warranty from the wholesale dealer that it was so; but, unless he has given due notice that he will rely upon this defence, he shall be liable to pay the costs of the prosecution.

In clause 26 it is provided that all penalties imposed, where prosecutions are instituted by the inspectors on behalf of the local authorities, shall be paid to such inspectors, and by them handed over to the local authorities for which they act, "to be applied towards the expenses of executing this Act, any statute to the contrary notwithstanding."

The great importance of this new provision will be at once apparent, and it ought to remove all the objections on the score of expense, which some Boards have urged against the appointment of an Analyst, as in many cases the amount of the fines will go a long way towards paying the cost of the prosecutions and the Analyst's salary. Hitherto, as is well known, the amount of the penalties recovered has gone to a general police fund.

Clause 27 provides a punishment for persons guilty of forging warranties, or uttering the same knowing them to be forged, of two years' hard labour; for persons misapplying a warranty (that is, using it for an article other

than the one it was given for), to a fine of £20; for persons giving a false warranty, a fine of £20; and for "every person who shall wilfully give a label with any article sold by him which shall falsely describe the article sold," a penalty of £20.

Clause 28 states that nothing in the present Act shall affect the power of proceeding by indictment, or take away any other remedy, or in any way interfere with contracts and bargains between individuals, and the rights and remedies belonging thereto; and it further enacts that, in any case where a prosecution for breach of contract is instituted, the plaintiff can recover, in addition to all other damages which he has sustained by the breach, "the amount of any penalty in which he may have been convicted under this Act, together with all costs paid by him upon such conviction and those incurred by him in and about his defence thereto."

Clause 30 makes special provision as to the examination of all tea imported, by persons to be appointed by the Custom House, and to this clause the tea trade attaches great importance.

It will, doubtless, stop, to a very great extent, the importation of adulterated tea, but will in no way interfere with an examination by Public Analysts of any suspected samples which may be submitted to them.

In the "Adulteration Act, 1872," the form of certificate was left entirely to the taste of the individual Analysts and Boards. In the "Sale of Food and Drugs Act, 1875," a set form is prescribed, which is printed as a schedule to the Bill. It is needlessly cumbrous and wordy, and presents the following objectionable features:—

- (1). The weight of the sample on its receipt is to be stated, unless this "cannot be conveniently done."
- (2). If the sample is found to be genuine, nothing but the bare fact need be stated; but, if it be adulterated, it is necessary to give the proportions of the component parts, or the quantity of the adulterant, thus involving a quantitative analysis.
- (3). In the case of "milk, butter, or any article liable to decomposition," the Analyst is to report specially whether any change had taken place in the article that would interfere with the analysis.

We have thus reviewed, as briefly as the nature of the matter allowed, the new Act, and, after dispassionately considering it, have arrived at the conclusion that, as far as it is possible to form an opinion of the working of an Act of Parliament which has not yet been put into operation, it is a sounder and more comprehensive measure than the one it repeals.

To those who have only seen the Bill as originally drafted, and formed their opinion on that draft, this expression of commendation will, doubtless, be surprising, but probably few Acts of Parliament of the same length have ever undergone a more complete metamorphosis in their passage through the two Houses.

It is not too much to say that the Act, as finally passed, is essentially a different measure to the one introduced in the early part of the session by the President of the Local Government Board, and that for the very numerous and important amendments introduced, the Society of Public Analysts may honestly lay claim to the largest share of credit.

CORRESPONDENCE.

OUR PATENT LAW.

To the Editor of the Chemical News.

SIR,—I am not about to controvert the remarks you have made upon the above subject, in noticing Mr Higgins's "Digest of Patent Cases."

My object is merely to relate the history of a case which occurred to myself, and which I believe may occur

again under the existing conditions of our Patent Law. It is not from any fear of consequences that I withhold the real names in this narrative, because all that can be done has been done long ago in regard to public exposure; and this too with no other result than the harmless expression of Pistol's desire to "horribly revenge." I intend, therefore, to follow the simple A B C style of narration, and for this purpose shall bring in a Scottish merchant named A., and an Englishman named B. Several years ago this merchant A. applied to me to assist him in the completion of a patent, which he wished to take out for the production of oil from bituminous coal. At that time I was on, what I supposed to be, terms of friendship with the man B., to whom indeed I had been, and then was of considerable use gratuitously. It did not consequently surprise me when this man offered me the use of his office and an open desk to carry on my correspondence with the merchant A; it seemed, in fact, a mere outburst of gratitude. Matters went on as may be supposed,—a carefully conducted set of chemical experiments ended in the realisation of an improved mode of distilling coal for the production of mineral oils. The merchant A. applied for a patent, only, however, to discover that a patent for the self-same thing, carried out in the self-same way, had been granted the day before to a "foreigner residing abroad."

Suffice it to say that this "foreigner" was traced out step by step, and at length fairly unmasked in the person of the Englishman B. As, however, the Scottish merchant A. had spent much money upon his experiments, no other recourse was left him than to purchase the patent of the man B., and this he did for the sum of £70 sterling.

Meantime, impressed with the idea that I was in collusion with the man B., the merchant A. discontinued to correspond with me; and I, thinking his silence an example of Scottish gratitude, quietly allowed our acquaintance to drop; nor was it until several years after that I got to know the real circumstances of the case, although during all this time I continued in my ignorance to render gratuitous services to the man B.

How much injury this thing did me in a professional point of view I have no means of knowing, nor do I very much care, for my position in life has placed me beyond the influence of such injury. But in a national aspect the matter assumes a more serious form, and perhaps, upon reflection, you may think the present efforts of the Lord Chancellor not altogether uncalled for, even though they may prove unsuccessful.

In my opinion the Patent Law ought to be entirely abolished, and a system of national rewards instituted in its place; but the discussion of this question would lead me beyond the limits of a scientific journal like yours.—I am, &c.,

LEWIS THOMPSON.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—My friend Mr. Rudler has unearthed an old fact or some significance, of which I had no idea.

There really existed a "British Mineralogical Society," which was blended with the Askesian Society before it went to the tomb of the Capulets!

One can easily understand, how, in the days of "*The Four Elements*" (1806), that "pure mineralogy was not sufficient to keep the Society in healthy activity."

In this year of grace, 1875, Mineralogy (alas! far from being pure and simple) *could* keep a society in healthful activity. There is no doubt about that.

If we had a Mineralogical Society just now, I would humbly ask of it information as to the minerals Kjerulfine, Uranosphærite, Uranospinite, Vaalite, and Zeunerite. Whether they happen to be old acquaintances with new faces, or strangers with an old appearance?

But we have no Mineralogical Society. I fancy there

ought to be one. Is it too late to do well? or too soon to begin?

T. A. READWIN.

Liverpool, August 23, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—My letter under this heading, which appeared in the CHEMICAL NEWS (vol. xxxii., p. 29) has led to my receiving a number of private communications from mineralogists who desire to join in the establishment of a "Mineralogical Society of Great Britain and Ireland."

It appears to me that a Mineralogical Society should aim at the following objects:—

1. To simplify mineralogical nomenclature.
2. To determine and define doubtful species.
3. To measure, determine, and illustrate forms of crystallisation, especially the irregularities and peculiarities of particular planes, or of crystals from particular localities.

4. To study the *Paragenesis* of minerals.
5. To record instances and modes of pseudomorphism with their accompanying phenomena.

6. To discuss rival systems of classification, and establish a natural system.

7. To promote the exchange of specimens.

8. To collect, record, and digest facts and statistics relating to economic mineralogy.

I have already received the names of several eminent mineralogists who are desirous of joining in this work, and shall be glad to receive as many other names as possible before further steps are taken in the matter.—I am, &c.,

J. H. COLLINS.

57, Lemon Street, Truro,
August 24, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Professor Dana's "System of Mineralogy" (1874) enumerates exactly 925 mineral species. (I tried to count the varieties, and "caved in.")

The "Index of the Mineral species with their varieties contained in the British Museum" (January 1, 1875), gives the names of 690 mineral species and 722 varieties.

Comparing the latter with the former, I find more than 200 discrepancies in nomenclature, and that our National Collection contains 235 fewer mineral species than are catalogued in Dana's "Mineralogy." Taking the more remotely-modern authors, the discrepancies become largely increased.

Also, I find, scattered up and down "our unsatisfactory mineralogical literature," something like 1166 so-called mineral species, and about 1650 varieties. A goodly number of these have been autocratically ignored by "the powers that be," albeit they were introduced to the world under the most respectable patronage of the time being. I have shown in previous communications that very many of these so-called mineral species are of extremely doubtful character, and that some of them appear to be rank impostors.

Some of the questions that naturally arise out of these simple statistics are:—

1. How is it (in what ought to approximate to an exact science) there are so many discrepancies in its nomenclature?

2. How is it that our National Collection lags so very far behind in the acquisition of authenticated mineral species?

3. Whether the points upon which the two great authorities are agreed are in themselves altogether appropriate (and, therefore, to be fixed for ever); whether the points on which they differ are irreconcilable; and, whether some other authorities outside the enchanted

circle, and differing from both the autocrats, may not be taken as equally reliable?

4. Whether and how it is possible to change a state of things that is at last admitted on all sides to be a disgraceful hindrance to the advancement of science?

Now, Sir, it has all along appeared to me that an independent Society of men (and women if they have a mind to), whose avocations and likings are more or less akin to the study of inorganic substances, can be the only remedy for the mineralogical ills that we have so innocently inherited.

A Mineralogical Society, as cosmopolitan as possible, may be an inexpensive society. A yearly fee of a guinea would amply suffice; and I cannot help thinking, Sir, that if you will only add a foot-note to the effect that notes of adhesion to this crude idea, addressed "*Mineralogical Society*," may be sent to your office, some good will come of it.—I am, &c.,

T. A. R.

Liverpool, August 31, 1875.

[We shall be glad to receive communications on this subject.—ED. C. N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 6, August 9, 1875.

Notice of a Blue Matter found in Clay.—M. P. Thenard.—The author exhibited a specimen of clay, which, when dug up a fortnight previously, was of a deep grey, but had since become black by exposure to the sun, with portions of a blue matter of the colour of ultramarine. The clay was obtained from the trenches of a water-mill which is being constructed at Perrigny sur l'Ognon (*Côte d'Or*), on the site of a forge, which has disappeared a century ago. This matter takes an olive-green if heated to 120°, and begins to change already at 100°. If treated in the cold with solution of potassa it turns yellow. Ammonia has no action, neither has acetic acid. Chlorine water modifies it but slowly; but hydrochloric acid, even very dilute, dissolves it at once, causing it to lose its colour, which an addition of ammonia does not restore. It contains a predominant quantity of ferrous oxide; ferric oxide and lime are wanting; alumina is present, though in smaller proportion than lime. There are notable quantities of a nitrogenous organic acid, and phosphoric acid is probably present. Silica is only in very small amount.

Calorimetric Study of the Silicides of Iron and Manganese.—MM. Troost and P. Hautefeuille.—Silicon in combining with manganese disengages much heat, and forms with this metal very stable compounds, as has been already demonstrated in case of carbon. The correspondence between silicon and carbon extends to their behaviour with iron, in which they both seem to dissolve, their union being attended with little, if any, disengagement of heat.

Researches on the Niobates and Tantalates.—M. A. Joly.—The researches of M. de Marignac on the alkaline fluo-niobates and fluo-tantalates have led to the formulæ Nb_2O_5 and Ta_2O_5 for niobic and tantallic acids respectively, which have been confirmed by the vapour-densities of the chloride, Nb_2Cl_5 ; and oxychloride of niobium, $Nb_2O_2Cl_3$; and of the chloride of tantalum, as determined by MM. Sainte-Claire Deville and Troost. Niobic and tantallic acids approximate, in their formulæ at least, to vanadic acid, which the researches of Prof. Roscoe have enabled us to classify, in accordance

with the totality of its chemical properties along with phosphoric and arsenic acids. The three latter acids may be tribasic, and their salts associated with fluorine and chlorine form apatites and wagnerites. The author finds that niobic acid in its combination with bases gives rise to four classes of salts— $\text{MO}, \text{Nb}_2\text{O}_5$; $2\text{MO}, \text{Nb}_2\text{O}_5$; $3\text{MO}, \text{Nb}_2\text{O}_5$; $4\text{MO}, \text{Nb}_2\text{O}_5$. He gives a detailed account of the niobates and tantalates of magnesia, the niobates of lime, manganese, iron, and yttria. Niobic and tantallic acids can be tetrabasic; and the author has not succeeded in producing with them compounds analogous to the apatites and wagnerites. Hence these two acids cannot be placed along with the acids of the phosphoric series.

Facts Relative to the Study of the Polyatomic Acids, properly so called: Application to a New Method of obtaining Crystalline Formic Acid.—M. Lorin.—85 grms. of erythrite are treated in successive portions with 2.4 kilos. of oxalic acid, and yields 1120 of aqueous formic acid, containing 985 of real acid, or 87.95 per cent. If the first aqueous acids are allowed to escape, we obtain formic acid of the average strength of 90.4, and for the last portions the average is 96. The rectification of these last portions furnishes acid of a strength exceeding 98 per cent, from which, by a duly regulated distillation, the crystalline acid is obtainable.

MISCELLANEOUS.

British Association for the Advancement of Science.—At the general meeting of the Association, held on Wednesday afternoon, Captain Douglas Galton stated that one of the principal functions of the Association was to spend the money it received in the promotion of science. There had already been spent by the Association £38,000. The list of grants, which was then read, included the following:—Mathematics and Physics. Professor Cayley, Printing Mathematical Tables, £159 4s. 2d.; Mr. Brooke, British Rainfall, £100; Mr. J. Glaisher, Luminous Meteors (£25 renewed), £30; Professor C. Maxwell, Testing the Exactness of Ohm's Law (renewed), £50; Professor Stokes, Reflective Power of Silver and other Substances (renewed), £20; Professor Tait, Thermo-Electricity (renewed), £50; Sir W. Thomson, Tide Calculating Machine, £200. Chemistry. Professor Roscoe, Specific volume of Liquids, £25; Dr. Armstrong, Isomeric Cresols and the Law of Substitution in the Phenol Series, £10; Mr. F. Clowes, Action of Ethylbromobutyrate on Ethyl Sod-aceto-acetate, £10; Mr. Allen, Estimation of Potash and Phosphoric Acid, £20. Mr. Bramwell moved a vote of thanks to the Mayor, the local officers, and Executive Committee, which was seconded by Professor Balfour Stewart, and cordially adopted. Mr. Griffith gave the following statement of the attendances and money received during the meeting at Bristol:—Old life members, 240; new life members, 36 (£359); old annual members, 296 (£296); new annual members, 93 (£186); associates, 884 (£884); ladies, 672 (£672); foreign members, 17. Total attendances, 2249; total money received, £2397. A vote of thanks to Sir John Hawkshaw, proposed by Sir William Thomson, seconded by Dr. Carpenter, and carried by acclamation, brought the successful meeting at Bristol to a close. The meeting of the British Association for 1876 will be held at Glasgow, and will commence on September 6. Sir Robert Christison, Edinburgh, has been nominated president elect, and the vice-presidents chosen are the Duke of Argyll, Sir William Stirling-Maxwell, Sir William Thomson, the Lord Provost of Glasgow, Dr. Allen Thomson, and Professor A. C. Ramsay. The meeting for 1877 will be held at Plymouth.

The following is a complete list of the papers brought before the Chemical Science Section of the Bristol Meeting, under the presidency of Professor A. Vernon Harcourt. They will be published in full or in abstract, according to their importance, in the CHEMICAL NEWS.

- Prof. T. E. Thorpe.*—Report of the Committee for the purpose of Determining the Specific Volumes of Liquids.
W. Chandler Roberts.—Report of the Committee for the purpose of Investigating the Methods of Making Gold Assays, and stating the results thereof.
Henry T. Chamberlain.—Some account of the Manufacture and Refining of Sugar in Bristol, 1875.
Thomas Davey.—The Tobacco Trade of Bristol.
A. S. Davis.—A Simple Method of Determining the Proportion of Carbonic Acid in Air.
A. Vernon Harcourt, F.R.S.—On an Apparatus for Estimating Carbon Bisulphide in Coal-Gas.
Professor A. W. Williamson, F.R.S.—Report of the Committee for the purpose of superintending the publication by the Chemical Society of the Monthly Reports on the Progress of Chemistry.
P. S. Evans.—On Tanning.
Dr. J. Watts.—On Muntz and Rampacker's Apparatus for the Estimation of Tannic Acid.
Dr. W. A. Tilden.—Researches on the Crystalline Constituents of Aloes.
G. H. Beckett and Dr. C. R. A. Wright.—On Japanese Camphor from Peppermint.
G. H. Beckett and Dr. C. R. A. Wright.—On the Alkaloids of the Aconites.
F. Clowes, B.Sc.—On the Action of Ethyl-Bromobutyrate on Ethyl-Acetosodacetate.
Dr. T. L. Phipson.—On Noctilucine.
Dr. H. E. Armstrong.—Report on Isomeric Cresols, and on the Law which governs Substitution in the Phenol Series.
Prof. Cayley.—On the Analytical Forms called Trees, with application to the Theory of Chemical Combinations.
P. Braham.—Some further Experiments on Crystallisation of Metals by Electricity.
J. W. Gatehouse.—On Nitrite of Silver.
T. Fairley, F.R.S.E.—On New Solvents for Gold, Silver, Platinum, &c., with Explanation of so-called Catalytic Action of these Metals and their Salts on Hydrogen Dioxide.
T. Fairley, F.R.S.E.—On the Use of Potassium Dichromate in Grove's and Bunsen's Batteries to ensure constancy.
A. H. Allen.—Report of the Committee for the purpose of Examining and Reporting upon the Methods employed in the Estimation of Potash and Phosphoric Acid in Commercial Products and on the mode of stating the results.
Prof. Corfield, M.D.—Report of the Sewage Committee.
J. C. Melliss.—Treatment of Sewage.
C. T. Kingzett.—On the Oxidation of Essential Oils.
Prof. A. Oppenheim.—Some remarks on Oxyuvitic Acid.
L. Jackson and A. Oppenheim.—Derivatives of Mercaptan.
Dr. H. E. Armstrong.—On the Nature of Berthelot's Vinylic Alcohol.
Professor T. E. Thorpe.—On a New Gaseous Compound of Fluorine and Phosphorus.
T. Fairley, F.R.S.E.—On a New Process for the Separation of Lead, Silver, and Mercury (Mercurous) Salts.
T. Fairley, F.R.S.E.—On a Process for the Preparation of Periodates, with their Application as a Test for Iodine and Sodium.
Dr. J. H. Gladstone.—The Relation of the Arrangement of the Acids and Bases in a Mixture of Salts to the Original Manner of Combination.
Dr. J. H. Gladstone and Alfred Tribe.—Notes on the Copper-Zinc Couple.
Dr. J. H. Gladstone and Alfred Tribe.—On the Augmentation of the Chemical Activity of Aluminium by Contact with more Negative Metals.
Dr. Debus.—On the Chemical Theory of Gunpowder.
A. H. Allen.—A Method of Effecting the Solution of Difficultly Soluble Substances.
W. Thomson.—Observations on Apparatus and Modes of Examining for the Source of Polluted Air.

THE CHEMICAL NEWS.

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A WORD TO STUDENTS.

Now the various colleges and schools of science are on the point of resuming operations, it may not seem out of place if we address a few words of advice to those who are about to commence or to continue their course of study. We would ask, in the first place, what is their real object? Do they seek to become sound, thorough, accurate men of science, hoping, in some direction or other, to extend the boundaries of human knowledge? Or is their purpose merely to "prepare" for some examination? Do they study to "know," or to "pass?" To the latter class we say very little. They require our pity, which would be largely mingled with contempt were we not aware that passing examinations is at present a necessary key to certain careers. Let those of them who are capable of better things, however, take courage. The day is coming when we shall recover from our present mania of imitating the Chinese, and when original research, and that only, will be the passport to honours and to official recognition.

To the genuine student, who seeks to measure his strength not against competitors, but against the unsolved mysteries of the universe, we say above all things, be a specialist! Make your selection according to your tastes, your faculties, and your opportunities, and then upon the branch so selected throw yourself with your whole time and your whole energies. Make yourself familiar with what has already been done in the department and acquire above all a mastery over the needful methods of research. In the course of your reading you will perceive where the unexplored ground lies, and the means of approaching it will at once suggest themselves to your mind if you examine the subject with perseverance and attention.

Now we know that the course we are suggesting is the very opposite to what the authorities of colleges will too often recommend. They do not like specialists. They set very little value on original research, because under our unfortunate regulations for higher education it counts for nothing in the eyes of the routine examiner. They will bid the student strive to become, in the cant phrase of the day, "a good man all round." This advice we consider essentially bad and misleading. In the first place the mere extent of every science is now so prodigiously enlarged that a thorough acquaintance with all sciences is simply impossible. The attempt at universal knowledge results in universal superficiality. Again, it is very common that a man who feels an eager interest in one branch of science is perfectly indifferent or even averse to others. Would it not be better both for himself and the world that he should concentrate his attention upon the former? It is strange and almost laughable that the division of labour, so fully recognised in practical life, is as yet so entirely ignored in the career of the student. We do not require the mason to be a proficient in saddlery, or the brass-founder in calico-printing. Yet we refuse to grant any degree to a chemist or a biologist unless he can pass certain philological tests!

It is obvious that the plan we recommend of special devotion to some one department of science from the earliest date when the peculiar bent of the student's mind can be recognised will not conduce to success at examinations. But we hold that examinations as at present conducted cannot in the least test the power of the student to undertake original research. The best originator, the man of fruitful, suggestive mind, is not by any means invariably the best learner. His brain is so full of novel ideas which he is busied in reducing into definite form and preparing for experimental verification that he is apt to turn a somewhat deaf ear to routine lessons. His mind is a *plenum*, into which entrance is difficult. We could if so inclined give numerous instances of great discoverers, living as well as dead, who, for this very reason have been counted as dunces in their school and college days. It is undoubtedly painful to any young man of ability and energy to find himself outstripped at examinations and regarded with contempt by shallow competitors and no less shallow teachers. But, says the old proverb, "He laughs best who laughs last." Who makes the better figure in the middle of life, "the good man all round" who has "passed" and then subsided into a decorous, but feeble mediocrity, or the specialist who has not "passed," but who can lay his hand on a pile of original investigations? To be useful to the world we must know some one thing well; and to succeed in life we must be able to do some one thing better if possible than any rival. The pansophist, great and original in every department of human knowledge, is as extinct as the megalasaurus, if, indeed, he ever existed.

One caution must be added: we have said that a man may be too great to succeed under the examination system. Let not, however, every one who makes a wretched figure at an examination delude himself with the notion that he is an original genius. If he is, he will soon prove it by his works.

EXAMINATIONS OF THE UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this examination is £2.

The Examination will be held on Monday, January 10th, 1876. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, and German. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected.

A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

The Papers in French and German will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

The Latin subjects for 1876 and 1877 are—

For January, 1876:—*Cicero*, De Amicitia and Pro Lege Manilia.

For June, 1876:—*Horace*, Odes, Books I. and II.

For January, 1877:—*Virgil*, Georgics, Book IV., and *Æneid*, Book IV.

For June, 1877:—*Horace*, Odes, Books III. and IV.

The Greek Subjects for 1876 and 1877 are—

For January, 1876:—*Xenophon*, Anabasis, Book VI.

For June, 1876:—*Xenophon*, Anabasis, Book II.

For January, 1877:—*Xenophon*, Hellenics, Book I.

For June, 1877:—*Homer*, Odyssey, Book XII.

The Questions in Natural Philosophy are of a strictly elementary character; they include Mechanics, Hydrostatics, Hydraulics, Pneumatics, Optics, and Heat.

The Examination in Chemistry is—Chemistry of the Non-Metallic Elements; including their compounds—their chief physical and chemical characters—their preparation—and their characteristic tests.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners has been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination possess sufficient merit, the first among such Candidates will receive an Exhibition of thirty pounds per annum for the next two years; the second among such candidates will receive an exhibition of twenty pounds per annum for the next two years; and the third will receive an exhibition of fifteen pounds per annum for the next two years; such exhibitions are payable in quarterly instalments, provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within three academical years* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a prize to the value of ten pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a prize to the value of five pounds in books, philosophical instruments, or money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has attained the age of eighteen years.

FIRST B.SC. EXAMINATION.

The First B.Sc. Examination will commence on Monday, July 19th, 1876.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of a higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the First Examinations in Arts, Science, and Medicine, and the Second Examinations of the next year in those Faculties respectively, is about sixteen months, whilst the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

The Examination embraces the following subjects* :—Mathematics, Mechanical Philosophy, including Statics, Dynamics, Hydrostatics, Hydraulics, Pneumatics, and Optics. (These subjects are treated independently of mathematical symbols, or only by simple geometrical methods.)

Natural Philosophy, including Heat, Electricity, Magnetism; Inorganic Chemistry, Botany, and Vegetable Physiology and Zoology.

PRELIMINARY SCIENTIFIC (M.B.) EXAMINATION.†

The Preliminary Scientific Examination will commence on Monday, July 19th, 1876.

No Candidate is admitted to this Examination until he has completed his seventeenth year, and has either passed the Matriculation Examination or taken a Degree in Arts in one of the Universities of Sydney, Melbourne, Calcutta, or Madras.

The Fee for this Examination is £5.

Candidates are examined in the following subjects of the First B.Sc. Examination‡ :—Mechanical and Natural Philosophy, Inorganic Chemistry, Botany and Vegetable Philosophy, Zoology.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in all the foregoing subjects of examination, and also in Practical Chemistry.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics and Mechanical Philosophy, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Mathematics and Mechanical Philosophy at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the First B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject. And any Candidate who has passed the Preliminary Scientific (M.B.) Examination in all its subjects may be examined at the Honours Examination next following the Preliminary Scientific (M.B.) Examination at which he has passed, in (1) Experimental Physics, (2) Chemistry, (3) Botany, and (4) Zoology; unless he has previously obtained an Exhibition in either of these subjects at the First B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Experimental Physics are examined in any of the following subjects, at the option of the Examiners:—Statics, Dynamics, Hydrostatics, Hydraulics, and Pneumatics, Optics, Heat, Electricity, Magnetism.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the

* Candidates who pass in all the subjects of the First B.Sc. Examination, and also at the same time in the Practical Chemistry of the Preliminary Scientific (M.B.) Examination, will be considered as having passed both the First B.Sc. Examination and the Preliminary Scientific (M.B.) Examination, without being required to pay an additional fee.

† Candidates who matriculated previously to January, 1861, will not be required to pass the Preliminary Scientific (M.B.) Examination in any other subjects than Chemistry and Botany; and they will be allowed to pass the Preliminary Scientific Examination and the First M.B. Examination in the same year, if they so prefer.

‡ Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and also at the same time in the Mathematics of the First B.Sc. Examination, will be considered as having passed both the Preliminary Scientific Examination, and also the First B.Sc. Examination, without being required to pay an additional Fee; and Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and who have previously passed the First B.A. Examination, will be admissible to the Second B.Sc. Examination.

Examiners:—Elementary Substances and their Combinations, Electro-Chemistry, Radiant Chemical Action.

In the Examination for Honours, the Candidate, not being more than twenty-two years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £40 per annum for the next two years.

SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination will commence on Monday, October 25th, 1876.

Candidates for this Examination who have not previously taken the Degree of B.A. are required either to have passed the First B.Sc. Examination at least one academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

The Examination includes the following subjects:—

Mechanical and Natural Philosophy.

Statics, Dynamics, Hydrostatics, Hydraulics, and Pneumatics, Optics, and Astronomy, Organic Chemistry, Animal Physiology, Geology and Palæontology, Logic and Moral Philosophy. (The four last subjects are treated Experimentally, and also Mathematically so far as the subjects of the First B.Sc. Examination are applicable to them.)

A Certificate, under the Seal of the University, and signed by the Chancellor, will be delivered at the Public Presentation for Degrees to each Candidate who has passed.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics and Natural Philosophy, (2) Logic and Moral Philosophy, (3) Chemistry, (4) Zoology, and (5) Geology and Palæontology. And any Bachelor of Arts who has passed the Second B.Sc. Examination in Chemistry and in Geology and Palæontology may be examined for Honours in one or more of the above-mentioned subjects, provided he has gone through the Pass Examination in the corresponding subject or subjects immediately before; unless he had previously obtained a Scholarship at the Second B.A. Examination in either of the subjects which are common to it with the Second B.Sc. Examination, in which case he is not admissible to the Examination for Honours in that subject.

The Candidate, being not more than twenty-three years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE.

The examination for the degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch occupies four days.

No Candidate is admitted to this Examination until after the expiration of two academical years from the time of his obtaining the degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year must give notice of their intention to the Registrar, and pay to him a fee of ten pounds on or before the 1st of April. If a Candidate fails to pass the examination, the fee is not returned to him; but he is admissible to any one subsequent D.Sc. Examination without the payment of any additional fee, provided that he give notice to the Registrar on or before the 1st of May.

For the degree of D.Sc., Chemical Candidates can be examined either in Inorganic or Organic Chemistry, but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge of the

Principal Subject, and a general acquaintance with the Subsidiary Subject or Subjects.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or Chemical Technology in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

CHEMICAL LECTURES & LABORATORY INSTRUCTION.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, from 11 to 1. One Course, £2 2s.

Two classes are held at St. Bartholomew's Hospital in each year, for the convenience of gentlemen who are preparing for the Matriculation Examination at the University of London—from October to January, and from March to June.

The chemical class is conducted by T. Eltoft, F.C.S. Fee, £2 2s.

The class is not confined to students of the hospital.

A class in the subjects required for the Preliminary Scientific Examination is held from January to July, and includes all the subjects required. Chemistry is taught by H. E. Armstrong, Ph.D. Fee, £1 1s. Fee for chemicals, £1.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES,

44, BERNERS STREET, W.

Conducted by Professor E. V. Gardner, F.A.S., M.S.A.

The Laboratory is open morning and evening throughout the year. Conveniences made for private students, whose studies are under the immediate charge of Professor Gardner and his Assistants.

The subjects of Geology, Botany, and Mineralogy are in the hands of competent teachers, whose arrangements depend upon the number of members joining the class or classes.

Courses of Lectures on Electricity, Galvanism, Magnetism, &c., embracing the department of "Experimental Science" required by the Government Council of Education, are regularly established, and can be joined at any time.

The classes on the Science and Practice of Steam, and of Photography, are formed three times a year. Times of meeting, by mutual arrangement of the students and the Professor.

A Matriculation Course of Lectures on Heat and Chemistry, commencing in October. Fee, £4 4s.. The same course can be pursued in private study, commencing at other periods if preferred. It embraces all that is required by the Government and London University Matriculation Examinations.

Tutorial Department.—Provision has been made by which gentlemen can be conducted through any or all of the different branches of study required for the various examining boards, viz:—Classics, Mathematics, English, Greek, Latin, French, German, Drawing (Mechanical, Free-hand, and Object), Mechanics, Chemistry, and the

Natural and Experimental Sciences—in the class-rooms at Berners College.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Lecturer on Chemistry.—Mr. G. Chaloner, F.C.S. Tuesdays, 8.30 to 9.30, commencing October 5.

Manipulation and Analysis.—Saturdays, 7 to 10 p.m. Under Mr. Chaloner's direction.

CHARING CROSS HOSPITAL AND SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday, Thursday, and Friday, at 11. One Session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One Session, £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects:—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

ST. GEORGE'S HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One Course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, and Friday, at 10. One Course, including the use of apparatus and materials, £4 4s.

Physiological Chemistry.—*Demonstrator*—Dr. Ralfe.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One Course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One Course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

KING'S COLLEGE.

Professor of Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

Assistant Demonstrator.—J. M. Thompson, F.C.S.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A Course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the Course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty

and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

III. For Students who have any Examination in prospect, or who require general guidance in their Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evening, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

II. May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 till 12.15 a.m. Fee, £5 5s. for the Course.

III. Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry.

Each Student works independently in the Laboratory, which is open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

LONDON HOSPITAL AND MEDICAL COLLEGE.

Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One Session, £7 7s.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One Session, £3 3s.

MIDDLESEX HOSPITAL MEDICAL COLLEGE.

WINTER SESSION.

(Lectureship vacant). Monday, Thursday, and Friday, at 3; Saturday, at 11. One Session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Monday and Thursday at 3; Friday, at 11.30. One Session, £3 3s.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S.

Inorganic Course.—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.

Organic Course.—Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

NORTH LONDON SCHOOL OF CHEMISTRY
AND PHARMACY.

54, KENTISH TOWN ROAD, N.W.

Conducted by Mr. J. C. Braithwaite.

The session 1875-76 commences on the 1st of October, when the Laboratory will be open for Instruction in Practical Chemistry.

The classes for Chemistry, Materia Medica, Botany, and Latin meet at 8 p.m. Fee to either class, 10s. 6d. per month.

As each pupil works independently, he can enter at any period to either Classes or Laboratory.

ROYAL POLYTECHNIC INSTITUTION,
309, REGENT STREET, W.

Scientific Department under the direction of Professor Edward V. Gardner, F.A.S., M.S.A., assisted by an efficient staff of Masters and Assistants.

Classes on Heat, Chemistry, Galvanism, Magnetism, and Electricity commence in October; they are adapted to meet the wants of gentlemen preparing for Matriculation, Woolwich, Sandhurst, or Direct Commissions.

The Chemical Laboratory is excellently fitted, and gentlemen can pursue their studies privately under the supervision of Professor Gardner. The Laboratory is open from 10 to 5 daily, and each evening from 7 to 10.

The Class and Experimental Rooms are fitted for the study of Photography, Steam, and the different branches of Physics.

The Fees for practical study are arranged according to the time occupied.

Private Rooms.—A new feature in the arrangements for scientific study at the Polytechnic is the setting apart of rooms especially fitted for the pursuit of experiments and investigations of a private nature. These can be secured, with or without professional assistance, by those who need such advantages.

ROYAL VETERINARY COLLEGE, CAMDEN
TOWN.

Professor of Chemistry.—Mr. R. V. Tuson.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One Course, £3 3s.

ST. MARGARET'S TECHNICAL DAY SCHOOL
FOR BOYS,

NEAR ARTILLERY ROW, VICTORIA STREET, WESTMINSTER.

Head Master.—Mr. Robert E. H. Goffin, F.C.S.

The object of the School is to supply a sound, practical Education, with especial regard to technical training, for boys from the age of seven years and upwards.

The School will be open to all boys on payment, in advance, of an entrance fee of 2s. 6d., and a tuition fee of 10s. per quarter.

Numerous Exhibitions are reserved for boys who have been for three years at least at any Public Elementary School or Schools in the Parishes of St. Margaret and St. John, Westminster, or the Parish of St. Luke, Chelsea, and have passed the Government Inspector's Examination in the standard suitable to their age and standing.

There are nine Senior Scholarships of £5 per ann., tenable for two years, and six junior of £3 per ann., tenable for two years, in the School.

There are also classes in Chemistry, Physics, &c., for Teachers during the winter months.

The Course of Education includes Mathematics; Theoretical and Applied Mechanics; Acoustics, Light, and Heat; Inorganic Chemistry; Electricity and Magnetism;

Practical Solid Geometry; Physical Geography; Animal Physiology; Steam and Steam Engines.

SCHOOL OF PHARMACY OF THE PHARMA-
CEUTICAL SOCIETY OF GREAT BRITAIN,

17, BLOOMSBURY SQUARE.

The School opens on Monday, the 4th of October.

Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, from 9 till half-past 10 o'clock, throughout the Session.

Lectures on Botany and Materia Medica, by Professor Bentley, on Thursday, Friday, and Saturday mornings at 9 o'clock, including a Course on Systematic and Practical Botany at the Gardens of the Royal Botanic Society's Gardens in the Regent's Park.

The Laboratories for practical instruction in Chemistry as applied to Pharmacy, &c., under the direction of Professor Attfield, will be open daily throughout the Session.

SCIENCE AND ART DEPARTMENT OF THE
COMMITTEE OF COUNCIL ON EDUCATION,
SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Mineral Chemistry, commencing October 4, 1875. A Course of Thirty Lectures on Organic Chemistry, commencing January 19, 1876. Fees—Lectures on Mineral Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Friday, October 1, 1875. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

Physics, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures (see page 124). The Course will commence on October 4, 1875. Fee for Lectures and Laboratory work, £10.

Metallurgy, by Dr. Percy, F.R.S. The course will consist of about Fifty Lectures, commencing on October 11, 1875.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Physics, Natural History, and Metallurgy.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, KENNINGTON ROAD.

The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy. All apparatus and chemicals are provided for the students. There is also a special department for Instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of 'Ten Months' Lectures on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for Practical Instruction from 10 till 4. Secretary, Mr. W. Baxter.

The Session commences on September 15th.

UNIVERSITY COLLEGE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

A. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

B.—ANALYTICAL AND PRACTICAL CHEMISTRY.

I. Birkbeck Laboratory.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 2nd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

II. Summer Courses.

1. *Elementary Course.*—About forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

2. *Senior Course.*—This Course consists of twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

C.—SUMMER MATRICULATION COURSE.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about twenty lessons in Practical Chemistry, and of an equal number of oral lessons. These lessons will begin on Tuesday, April 25, 1876, at 11 a.m.

The class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the class has assembled.

Fee, including cost of materials and apparatus, £4 4s.

WESTMINSTER HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.R.S., F.C.S. Wednesday, Thursday, and Friday, at 3 p.m. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.R.S., F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One Course, £3 3s.

Special instruction can be obtained in the laboratory by gentlemen, whether pupils of the school or not, on application to the Lecturer. This will enable Students to become practically acquainted with the analysis of water, the detection of adulteration, and other chemical processes, a knowledge of which is necessary for an Officer of Health or a Public Analyst.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Friday, 7 to 10; and Saturday, 3 to 6 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professors of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Wednesday, and Friday, at 8.30. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.
Jacksonian Professor of Natural History.—J. Dewar, M.A.

Demonstrator.—J. W. Hicks, M.A.

LECTURES IN MICHAELMAS TERM.

Chemistry, general principles, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Spectroscopic Analysis, by the Professor.

Dissociation, and Thermal Chemistry, by the Jacksonian Professor, Tuesdays and Thursdays, at 12.

Practical Chemistry, by the Demonstrator, daily.

Principles of Qualitative Analysis, by Mr. Main, at St. John's College.

Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN LENT TERM.

Chemistry, general principles continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Organic Chemistry, by the Jacksonian Professor, Tuesdays, Thursdays, and Saturdays, at 12.

Analysis, by the Professor or Demonstrator, daily.

Elementary Chemistry, by Mr. Main, at St. John's College.

Non-Metallic Elements, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN EASTER TERM.

History of Chemical Philosophy, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Laboratory Instruction in Chemical research, by the Jacksonian Professor.

Analysis, daily.

Elementary Inorganic Chemistry, by the Demonstrator.

Chemistry, continued, by Mr. Main, at St. John's College.

Organic Analysis, and Elementary Organic Chemistry, by Mr. Apjohn, Gonville and Caius College.

The Chemical Laboratory of the University is open daily, from 10 a.m. until 6 p.m., for the use of Students, under the direction of the Professor. The Demonstrator or Assistant Demonstrator attends there daily to give instruction in manipulation.

ROYAL AGRICULTURAL COLLEGE,
CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor of Chemistry.—A. H. Church, M. A. Oxon.

Assistant.—R. C. Woodcock, F.C.S.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

36 Lectures on Inorganic Chemistry.

36 Lectures on Organic Chemistry.

36 Lectures on Agricultural Chemistry.

36 Laboratory Lessons in Chemical Manipulation.

36 Laboratory Lessons in Qualitative Analysis.

36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF
MEDICINE.

Chemistry and Practical Chemistry.—J. Campbell Brown, D.Sc. Lond., F.C.S.

The first half of the Course, to Christmas, includes all the branches of Chemistry required for the Matriculation Examination of the University of London.

The Course consists of 100 Lectures. Fee, £5 5s.

Technological and other non-medical Students may take out any of the divisions separately—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The Laboratories accommodate eighty working Students. Fees, from £1 1s. to £4 4s. per month.

ANALYTICAL LABORATORY AND SCHOOL OF
TECHNICAL CHEMISTRY,

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.).

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for Lectures and practical work.

LIVERPOOL SCIENCE AND ART CLASSES.

Chairman.—Mr. James Samuelson.

Honorary Secretary.—Mr. Michael Fitzpatrick.

These Classes will commence on September 22nd.

Inorganic Chemistry, Elementary Course, at Queen's Road Board Schools.

Lecturer.—Mr. Hugh Hughes.

Lectures, Tuesdays, 7 to 8 p.m.; Laboratory Practice, 8 to 10 p.m.

Inorganic Chemistry, Advanced Course, at 7 and 9, Hackin's Hey.

Lecturer.—Mr. Norman Tate.

Lectures, Fridays, 7 to 8 p.m.; Practice in Qualitative and Quantitative Analysis, 8 to 10 p.m.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

The Student's Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. There will also be Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS MECHANICS' INSTITUTION AND
LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commence on Friday, October 1, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

Professor of Chemistry.—T. E. Thorpe, Ph.D., F.R.S.E., F.C.S.

Lecture Courses.

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 9.30 a.m., from October to the end of March. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., from October to March. Fee, 10s. 6d. This class is chiefly intended for Schoolmasters and their Assistants: it will not be held unless a sufficient number enter.

4. Lectures on Chemical Technology. A course of

eight lectures on the *Chemistry of Tanning* will probably be given during the summer.

Laboratory Courses.

Professor T. E. Thorpe, Ph.D., F.R.S.E.

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three, £11 11s.; two, £8 8s.; one, £4 4s.

Special fees for shorter periods—For six months, six days per week, £13 13s.; five, £11 11s.; four, £9 9s.; three, £7 7s.; two, £5 5s.; one month, £3 3s.

Schoolmaster's Class on Practical Chemistry, Saturday mornings, from 9 to 12, from October to March. Fee, £1 11s. 6d.

Practical Chemistry for Medical Students.—On Monday and Wednesday, from 9 to 11 a.m., from May to the end of July.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Master.—Francis Jones, F.C.S., F.R.S.E.

Assistant Master.—R. L. Taylor, F.C.S.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry, Botany, Geology, and Mineralogy. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

MANCHESTER MECHANICS' INSTITUTION.

Inorganic Chemistry.

Lecturer.—M. A. Watts, M.A. Friday evening, 7.15 to 9.15.

Practical Chemistry.

Friday evening, 8.15 to 9.15. This class will be open to those Students only who attend a lecture course also.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Chemistry.—*Professor*—A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, Assoc. Phys. Science.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees*.—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may elect.

The Session will commence on the 5th of October, 1875.

Evening Classes.—Professor A. Freire-Marreco, M.A. Twelve Lectures on Inorganic Chemistry. Mondays, at 7.45, commencing November 1, 1875.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

OWEN'S COLLEGE, MANCHESTER.

Professor and Director of the Chemical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor of Organic Chemistry.—C. Schorlemmer, F.R.S.

Demonstrators and Assistant Lecturers.—Mr. W. C. Williams, F.C.S., and Mr. M. M. Pattison Muir, F.R.S.E.

Hon. Demonstrators.—Mr. Thomas Carnelley, B.Sc., and Mr. Oswald Wilkinson.

Lecture Courses.

Systematic Chemistry.—*Junior Class*—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (a) of Experimental Lectures and (b) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Monday and Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows:—

1. Twenty Lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.

2. Twenty Lectures on the Chemistry of Colouring Matter, Dyeing and Calico Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—Professor C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Regular Students, or those preparing for Degrees, may enter for two days a week at a fee of £9 9s. All other Students will be required to enter according to the following scale, and those working in the Quantitative Laboratory will be required to enter for not less than four days per week.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

QUEENWOOD COLLEGE.
NEAR STOCKBRIDGE, HANTS.

The Science Department of the above College is under the direction of E. W. Prevost, Ph.D., F.C.S., F.R.S.E. Lectures are delivered during term time on Chemistry and Natural Philosophy, and a well-appointed Chemical Laboratory is used by all but the youngest pupils. The Course of Instruction is well suited to meet the requirements of the London University and College of Surgeons Examinations.

Principal.—C. Willmore.

BOROUGH ANALYST'S LABORATORY,
1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF ABERDEEN.

Professor of Chemistry.—J. S. Brazier.

ABERDEEN SCHOOL OF SCIENCE AND ART
MECHANICS' INSTITUTION.

Subject.—Chemistry, with Laboratory practice.

Teacher.—Thomas Jamieson, F.C.S.

Fees, 10s. per Session, Apparatus, &c., extra. Session—November to April inclusive.

ANDERSONIAN UNIVERSITY, GLASGOW.

DEPARTMENT OF SCIENTIFIC CHEMISTRY.

Professor.—W. Dittmar, F.R.S.E., &c.

Senior Assistant.—R. W. Emerson MacIvor, F.C.S.

Junior Assistant.—W. S. Curphey.

A Course of One Hundred Lectures on Inorganic and Organic Chemistry will be commenced at the end of October. Fee, £2 12s. 6d.

The Laboratory will open at the beginning of November. Fee for the Winter Session (inclusive of gas, reagents, &c.), £12 12s.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

SCHOOL OF CHEMISTRY.

138, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr. Clark.

Lectures on Inorganic and Organic Chemistry and Laboratory Instruction in Analytical and Practical Chemistry.

CHEMICAL LABORATORY AND CLASS ROOMS.

144, WEST REGENT STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 to 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m., commencing November 2.

ANALYTICAL LABORATORY,

88, HOPE STREET, GLASGOW.

Dr. A. T. MACHATTIE, F.C.S.

The Instructions in Analytical and Practical Chemistry and Practical Medical Chemistry are conducted daily from 10 a.m. till 5 p.m., under the personal superintendence of Dr. Machattie.

Attendance qualifies for Examination by the faculty of Physicians and Surgeons, Glasgow; the Royal Colleges of Physicians and Surgeons; and other Public Boards.

IRELAND.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

TRINITY COLLEGE, DUBLIN.

Professor of Chemistry.—Dr. J. Emerson Reynolds.

ROYAL COLLEGE OF SURGEONS IN IRELAND.

Professor of Chemistry and Hygiene.—Charles A. Cameron, M.D., F.R.C.S.I.

Principal Assistant.—Edwin Lapper, F.C.S.

Fee for course of Winter Lectures, £3 3s. Fee for three months' course of Instruction in Laboratory, £3 3s. Fee for six months' special Instruction in Sanitary Chemistry, £10 10s.

An additional Laboratory for Students has recently been built.

GOVERNMENT AGRICULTURAL INSTITUTION,
GLASNEVIN, CO. DUBLIN.

Fifty Lectures on Agricultural Chemistry and Geology are annually delivered in this institution by Dr. Charles A. Cameron.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,
STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

Professor of Experimental Physics.—W. F. Barrett, F.R.S.E., F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

The Session commences on Monday, October 4th.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

INSTRUCTION IN PHYSICS AT SOUTH KENSINGTON.

THE practical instruction now imparted in the physical laboratories at South Kensington is of a most useful and comprehensive character. We are indebted to Dr. Guthrie for the following notes which were used during the last session; they will, we are convinced, prove of value to both teachers and students. We have omitted the notes on electricity and magnetism as they have already appeared in *The Electrical News and Telegraphic Reporter* for September 9.

In sending the notes Dr. Guthrie wrote as follows:—

"To the Editor of the Chemical News.

"SIR,—The accompanying notes were used by the Laboratory Students in Physics during the three months' course in the session 1874—75. For the science teachers, the courses on Light and Heat are somewhat extended, for we were able in the summer to devote three clear weeks to each of these subjects. I hope next year to be able to extend Molecular Physics, Sound, Electricity, and Magnetism in a similar way.

"This instruction has grown up during the last three or four years. Four years ago Prof. Goodeve and I drew up a 'Sketch of Experiments' (chiefly from our lecture notes) for distribution amongst science teachers. When I undertook to give practical instruction in physics to science teachers, students of the School of Mines, and teachers in training, it was found necessary to give rather more minute instructions, especially concerning the making of apparatus. The gentlemen who have from time to time been good enough to give me the advantage of their co-operation in conducting the practical courses are Prof. Barrett, Prof. Foster, Prof. Goodeve, Mr. Haddon, Prof. Pedler, Dr. Pike, Prof. M. Simpson, Mr. Wilson, and Dr. Wormell. I will answer for it that they all, as readily as I, put these notes unreservedly in your hands if you think they will be useful to your readers.—I am, &c.,

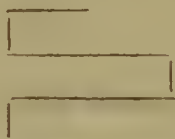
FREDERICK GUTHRIE.

Science Schools, South Kensington,
August 17, 1875.

Heat.

Make a differential thermometer.

Bend glass tube, about 2 ft. long, six times at right angles thus—



Fill middle portion with coloured alcohol to stand about 2 ins. high in each stem. Fit small flasks on ends of tubes with corks, making joints air-tight with sealing wax if necessary. Mount on wood stand, and affix paper scale. (See below.)

Ascertain range of differential thermometer, and graduate in Centigrade degrees.

Alcohol in thermometer tube being at same level on both sides, mark as zero on scale. Immerse both bulbs equally in vessels of water. Increase temperature of water in one of the vessels until alcohol column has risen to greatest possible height on one side; mark this point on scale. Ascertain difference of temperature between the vessels, and divide range into same number of degrees and decimal parts of degrees.

Make an alcohol thermometer.

Blow strong bulb about $\frac{3}{4}$ -inch diameter on end of thermometer-tube; allow to cool. Gently heat bulb in flame, and immerse open end of tube in coloured alcohol, which will enter bulb as it cools. Repeat this if necessary until very little air is left in bulb. Shake this air up into open end of stem. When bulb at ordinary temperature, raise it 10° or 20° by immersion in hot water, observing movement of

liquid in tube: so ascertain range of instrument, and adjust quantity of liquid accordingly. Now cool bulb with freezing-mixture. When liquid at lowest point seal open end of tube in blowpipe flame.

Graduate alcohol thermometer.

Immerse thermometer in melting ice, and mark zero thus obtained on the tube with ink or black varnish. Mark also intervals of 10° upwards by comparison with mercurial thermometer placed in water at required temperatures. Mount thermometer on wood, and attach paper scale.

Make bulb for determining expansions.

Blow strong bulb at least 1 inch diameter on stout thermometer-tube. Cut off tube 3 inches from bulb.

Determine mean coefficient of expansion of glass of thermometer tubing for 50° C. above the temperature of the day.

Weigh bulb-tube (No. 1) full of mercury at temperatures t and T , and so obtain coefficient of apparent expansion of mercury ($=B$). (See next experiment.) Then, assuming coefficient of real expansion of mercury as 0.00018 ($=C$), $C - B =$ mean coefficient of glass.

Determine mean coefficients of absolute expansion of water and alcohol between temperature of the day and 50° C. above.

Weigh bulb-tube filled with liquid at temperatures t and T . Calling weight of liquid at t W , and loss of weight at T w , the coefficient of apparent expansion is

$$\frac{w}{W - w}$$

The real expansion is obtained by adding to this the coefficient of expansion of the glass.

Make apparatus to illustrate method of measuring absolute expansion of a liquid.

At 12 inches from one end of small glass tube 30 inches long reduce considerably bore of tube by softening in blowpipe flame. Bend tube at right angles about an inch below contraction. Bend again at right angles from first elbow. Cut tube, if necessary, so as to make limbs of equal length. Coat each limb of tube with thin layer of bees'-wax containing a little turpentine. Fasten tube down on table by means of bees'-wax. Similarly fasten down steel millimetre scale of distance of 3 feet from tube, and so that longest axes of scale and one limb are in same straight line. Make fine hole through each end of wood rod 3 feet long, and fix in each hole a large needle, so that point projects about half an inch. Placing one of the points successively in each division of the steel scale, scratch corresponding divisions through the wax on glass with other point, making each fifth and tenth division of suitable length. Shift scale, and similarly graduate other limb. Brush with diluted fluoric acid, and leave for about half-an-hour. Take up tube, wash off acid with plenty of water, then remove wax. Upon each limb fix outer tube about $\frac{1}{8}$ -inch diameter and 10 inches long by means of corks at each end. Make four elbows of small quill tube, and fit one through each cork. The contraction on one limb should be just within cork.

Determine coefficients of absolute expansion of mercury and of water with above apparatus.

Fix the apparatus vertically in clip, and fill inner tube with the liquid so that level of liquid is just above cork in each limb. Pass steam through outer tube of limb with contraction until liquid in tube within is at 100° C. Pass water of known temperature through outer tube on other limb. Note length of liquid column in each limb. Calling length in cold limb H , length in hot limb h , and difference of temperature t , the coefficient of expansion for 1° is—

$$= \frac{h - H}{H t}$$

Make liquid conductivity cones.

Make two tin-plate cones, bases $2\frac{1}{2}$ inches diameter and 3 inches high, with tubular necks 1 inch long $\frac{1}{2}$ inch in diameter. On necks fit corks. Make wood support, consisting of an upright piece 8 in. \times 2 in. \times $\frac{3}{8}$ in., to which are fixed at right angles, two other similar pieces $3\frac{1}{4}$ inches long. Make holes in cross pieces to receive corks, so that bases of cones are immediately opposite each other. In neck of one cone fix cork, having through it a glass quill tube 30 inches long, lower end of which, when in use, dips in coloured liquid; lower cone and tube acting as an air thermometer. Fit with paper scale.

Compare with above apparatus conductivities of water, alcohol, turpentine.

Fix apparatus on edge of table. Heat lower cone slightly, so that when it cools, liquid will rise in tube to within about 6 inches of neck. Place between bases of cones a disc of known thickness (about 2 m.m.) Remove disc and introduce, by means of a pipette, the liquid to be examined, so that it completely fills the space between the cones. Note height of liquid in tube. Pour into upper cone water at known temperature (about 20° C. above that of room). Note depression of index column at end of one minute. Repeat experiment with other liquids, using in each case same volume of warm water at same temperature.

Make and use a Faraday's convection apparatus.

Fit large test-tube with cork, through which pass and fix two quill-tubes, one of which goes nearly to bottom of test-tube, the other terminating immediately below cork. Fit piece of glass tube, 6 inches long and about same diameter as test-tube, with cork at one end; through this cork pass and fix upper ends of quill-tubes, the tube which goes to the bottom of test-tube terminating just above cork, the other going to within an inch of the top. The two vessels should be about six inches apart, the small tubes may be straight, but are better if bent so as to give liquid a longer path. Fill completely lower vessel with coloured water, tubes and upper one with clear water. Gently warm lower vessel, when water will circulate.

Make and use apparatus for illustrating principles of ventilation.

Make zinc hoop 1 inch broad to loosely fit bottom of large paraffin lamp chimney. Solder hoop on piece of sheet zinc 3 inches square. Solder stout pin to stand vertically on centre of zinc plate within hoop. Make T-shaped sheet tin diaphragm about 4 inches long, to fit loosely in upper part of chimney. Place short lighted candle on pin, put a little water within hoop and place chimney over. First use apparatus without diaphragm, when candle will go out. Repeat experiment with diaphragm, the candle will not now be extinguished, inward and outward air currents being established in chimney. The existence of these currents may be shown by means of smoky brown paper.

Determine specific heats of iron, copper, zinc, tin, lead.

Heat substances in boiling water to 100° C. Immerse quickly beneath surface of known weight of water at known temperature. Then specific heat of substance

$$= \frac{\text{weight of water} \times \text{its gain of temperature.}}{\text{weight of substance} \times \text{its loss of temperature.}}$$

Apply to above results correction for containing vessel.

Multiply weight of vessel by its specific heat, thus obtaining water value of vessel.

Note.—A piece of tinfoil, folded as for a filter and supported on cotton-wool in a beaker, or cardboard cylinder, forms an easily made and suitable vessel for taking specific heats.

Determine specific heats of turpentine and mercury.

Heat liquid to 80° or 90° C., pour into water and use formula given above.

Determine specific heats of alcohol and turpentine from specific heat of iron found.

Substitute the liquid for water. Divide specific heat of iron by result thus found.

Ascertain number or heat units required to fuse unit weight of ice.

Place known weight of ice in larger known weight of water heated to about 60° C. Note temperature as soon as ice is entirely melted. Knowing number of heat units lost by hot water, and number of heat units gained by melted ice in rising to final temperature, calculate number required to fuse the ice. Divide this result by weight of ice.

Determine number of heat units required to convert unit weight of water into steam.

Fit flask with perforated cork and glass delivery tube. Boil water in flask, and when all air is expelled conduct steam into known weight (W) of cold water at known temperature (t) until temperature of water rises to 100° C. When cool find increase of weight (w). Then the number of heat units required will be—

$$\frac{W(100 - t)}{w}$$

Verify results obtained in No. 2.

Repeat the experiment, removing steam pipe when the temperature of the water has risen to 50° or 60° C. Proceed as before, but allow in calculation for the heat lost by the condensed steam in falling to the final temperature.

Make reflecting galvanometer for thermo-electric experiments.

Through piece of wood 5 in. by 2 in. by $\frac{3}{8}$ in., at 1 in. from end, cut circular hole 1 inch diameter with centre-bit, and at 3 inches from end cut another hole $\frac{3}{4}$ inch diameter. Cut slot $\frac{3}{8}$ inch wide, connecting the holes and continued to end of board. Fix board vertically on centre of wood block 4 inches square, slot being at the top. Make two circular coils, one inch internal diameter, each consisting of 50 turns, No. 20 covered copper wire. Make sheet zinc clips for fixing coils to board. Make U-shaped brass wire staple one inch wide, fitted with cork roller and fix over slot, so that one edge of cork is over centre of board. At one end of piece of aluminium or magnesium ribbon $2\frac{1}{2}$ inches long make fine hole, on other end fix a circular disc of zinc foil $\frac{5}{8}$ inch diameter. On this cement a strip of magnetised watch-spring $\frac{5}{8}$ inch long. At a distance of $1\frac{3}{8}$ inches from magnet fix on ribbon a similar magnet with poles reversed and carrying a silvered circular mirror of microscope glass $\frac{3}{4}$ inch diameter. (See instructions for silvering glass.) Suspend ribbon by fine raw silk fibre from cork roller, adjusting height by means of latter until mirror and disc swing freely within their respective spaces. Fix wire coils on board, one on each side of upper hole. Solder together two ends of coils so that current may flow through both in the same direction. Solder two free ends to binding screws fixed on base board. Make cardboard cover for instrument with glass front. On centre of top fix a cork and in cork a vertical brass wire about 4 inches long. Attach small bar magnet about 3 inches long to a cork; through latter make hole so that, magnet being horizontal, it may slide upon vertical wire and control small magnets below.

Make a thermopile.

In block of wood $1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{2}$ inch make 32 holes, size of wire given, arranged in four parallel rows, so as to form a square. Cut 16 straight pieces of German silver wire 1 inch long and 16 similar pieces of

iron wire. Thrust wires through holes so as to project equally on each side; holes 1, 3, 5, &c., being filled with iron, and holes 2, 4, 6, &c., with German silver wire. Solder alternate ends of wires together so as to form a continuous series. Solder copper connecting wires to free ends.

Make apparatus for showing influence of surface on absorption.

Cut two circular tin-plate discs 6 inches diameter. To centre of each solder, at right angles, a small bar of bismuth. To other end of the bismuth bar solder short piece of covered copper wire. Make hole through a cork, place over bismuth bar and over cork solder tin-plate cover. Lead copper wire out through cork, taking care that it does not make contact with tin. Solder a covered copper wire 3 inches long to edge of each plate. Mount plates on wood stands. Black face of one plate, leaving the other bright. To use the apparatus, place the plates parallel, a foot or so apart, with their faces turned towards each other. Connect edges of plates by a wire and connect the wires leading from bismuth bars to reflecting galvanometer. Place a hot ball or flame exactly half way between the plates: in a few seconds the galvanometer will be deflected in such a direction as to indicate that the blackened plate has become more heated than the bright one.

Ascertain temperatures at which the following salts solidify with water as cryohydrates:—Nitrate of potassium, sulphate of copper, chloride of ammonium.

Make saturated solution of the salt in water and half fill small test-tube therewith. Place thermometer in solution and plunge the whole into freezing mixture of ice and salts. Note temperature at which solution solidifies.

Ascertain lowest temperatures to be got by mixing each of the above salts with crushed ice.

Surround small beaker with flannel or other non-conducting material. Mix within it one part, by weight, of the salt with about three parts of ice. Note, by thermometer, lowest temperature obtained.

For the same salt, the temperature of solidification as a cryohydrate and the lowest temperature obtainable by mixing it with ice are identical.

Light.

Verify the law of inverse squares.

Using candle flame, or small gas flame, as source of light, cast a shadow of a book or square of cardboard upon screen or wall at distance of 10 feet from the light. Measure object and measure shadow which it casts when placed at distances of $2\frac{1}{2}$, 3, $4\frac{1}{2}$, 5, $6\frac{3}{4}$, and 8 feet from source of light. Note these dimensions and ascertain if they agree with theory.

Compare illuminating powers of candle flames, gas burners, &c., by shadow test.

At a short distance in front of wall or screen, fix a vertical rod. Place one of the lights (A) at a measured distance (d) from the screen, so that it throws a shadow of rod. Place second light (B) in such a position that it throws another shadow of the rod very near to the first one, and at such a distance (D) from the screen that the two shadows are exactly equal in intensity. Then the illuminating power of A : illuminating power of B :: d^2 : D^2 .

Repeat preceding experiments with Bunsen photometer, and compare results.

Place lights to be compared, one at each end of scale; move paper disc until grease spot is no longer distinguishable from surrounding paper. The illuminating powers of the lights are then in the proportion of the squares of their distances from paper disc.

Make a pin hole camera.

Make strong cardboard tube, blackened inside, about

10 in. long \times 2 in. diameter by rolling strip of cardboard round wood cylinder, fastening with glue, and withdrawing wood. Close one end of tube with stout paper, and when dry make pin-hole in centre of end. Make another similar tube to slide within the first, the end, which goes into first tube, being closed with tissue or tracing paper. Directing pin-hole towards window or other brightly illumined object, and looking into other end of tube, an image will be seen on tracing paper. On sliding tube farther in or out, size of image will alter.

Make a reflecting circle.

Cut circle of cardboard 12 in. diameter and graduate it to single degrees. Fix on board and attach two pointed cardboard arms by a screw passing through centre of circle, so that they may move like watch-hands and reach to within $\frac{1}{8}$ in. of edge. Fix small mirror on upper arm exactly over centre of circle and at right angles to direction of arm and plane of circle. On extremity of other arm fix pin, taking care that it is at right angles to plane of circle. Mount on board a short glass tube blackened inside so that axis of the tube is in a line with zero and centre of the circle. The mirror should have a vertical line drawn upon it exactly over centre of circle; the image of pin being made to coincide with this line when instrument is used.

Verify law of reflection with above instrument.

Place both arms pointing to zero; the pin should then exactly cover its own reflection. Move arm carrying pin to 10° ; it will be found necessary to move pointer to 5° in order to see image at centre of mirror. If pin moved to 20° pointer will have to be moved to 10° . In this way try various angles of incidence.

N.B.—Observe that in above experiments the angular motion of the reflected ray is always double that of the mirror.

Use instrument as sextant.

The silvering on upper half of mirror being removed so that an object in a line with eye tube and a reflected image may be seen simultaneously, the pointer is to be set at 0° . The mirror being now moved so as to make reflected image of A coincide with B, which is viewed directly; twice the complement of the angle indicated by pointer = the angle between A and B.

Make a glass millimetre scale.

Coat slip of glass 12 in. \times 1 in. with thin layer of bees'-wax. Fasten slip down on table with bees'-wax at each end. Similarly fasten down steel millimetre scale at distance of about 3 ft. from slip and so that longest axes of scale and slip are in same straight line. Make fine hole through each end of wood rod 3 ft. long and fix in each hole a large pin, so that point projects about $\frac{1}{2}$ in. Placing one of these pins successively in each division of the steel scale, scratch corresponding divisions through the wax on glass with other pin, making each fifth and tenth division of suitable length. Lay strip of blotting paper wetted with diluted fluoric acid on glass slip and leave for about half an hour. Take up slip, wash off with plenty of water; then remove wax.

Make instrument for measuring vertical heights by reflection.

On board 12 in. \times 3 in. \times $\frac{5}{8}$ fix slip of wood 10 in. \times 1 in. \times $\frac{5}{8}$. At one end of slip fix a similar one to stand vertically, the upper end of vertical slip having a thin clean edge, or better, carrying a horizontal metal slit. Make sheet zinc saddle to slide along horizontal slip carrying on it small piece of silvered glass. Rule a line across centre of glass and graduate paper scale on horizontal slip to indicate distances (in millimetres) between line ruled on glass and foot of vertical slip. Make small spirit level and fix on base board.

Use instrument for measuring heights of ceilings, doors, &c.

Having levelled the base board, look over edge of vertical slip (or through slit) and move mirror until top of wall is seen reflected at centre of mirror. Measure distance from mirror to foot of wall. Call this distance D , the height of wall H , distance on scale of centre of mirror from vertical slip d and height of vertical slip h . Then $d : h = D : H$.

Make circle dividing board.

On a piece of cardboard 14 in. square strike a circle 12 in. diameter with lead pencil. Glue margin outside circle and fix on deal board 14 in. square $\times \frac{3}{8}$ in. On upper side of card describe circle concentric with the other and also of 12 in. diameter. Graduate outer rim into single degrees. Cut out and remove central portion of card. At centre of circle make fine hole and through it from below thrust a stout pin, so that point of pin projects 1 inch above board. Make arm of sheet zinc 8 in. long $\times 1\frac{1}{4}$ wide with hole at one end to fit pin and having one side parallel to radius of circle.

Make multiple image apparatus.

Graduate cardboard semicircle 4 in. radius and mount on deal board 8 in. \times 4 in. Protect backs of two pieces of silvered glass 4 in. \times 2 in., with paper attached by thin glue. Fix stout brass wire pin 5 in. long, vertically at centre of circle. Fix stout paper loops on mirrors so that they hinge upon the pin.

Use apparatus to illustrate law of multiple images.

Incline the mirrors at various angles. Place an object between them and show that $\frac{360^\circ}{N^\circ} - 1 = \text{number of images seen}$; N being the angle between mirrors.

Make concave and convex mirrors.

Clean watch-glasses with nitric acid and tuft of cotton-wool inserted in end of piece of glass tube. Wash first in common water, then with alcohol, and finish with distilled water. Place glass in beaker containing silvering solution, the side to be silvered being upwards. Leave for about three quarters of an hour. Pour off solution and remove glass, being careful not to damage the silvered surface. Remove any silver deposited where not required. Wash in water, allow to become thoroughly dry, then coat silvered surface with thin shellac varnish. Solder together two strips of zinc at right angles, bend ends so as to form a kind of claw in which to hold the mirror. Solder brass wire stem to centre of cross and fix in wood block.

Determine principal focus of concave mirror.

Place mirror, screen, and source of light in same straight line, being careful that the principal axis produced passes through the screen and source of light. Measure distance between source of light and mirror, move screen until a distinct image is produced. Again measure distance between screen and mirror. Insert the numbers so obtained in the following formula:—

$$\frac{1}{u} + \frac{1}{v} = \frac{2}{R} = \frac{1}{f}$$

where u and v are the distances between mirror and source of light and mirror and screen, R radius of curvature, and f focal length. Verify result by altering distance between source of light and mirror. Use as screen a piece of tracing stretched on wire ring. The distinctness of the image will be greatly improved by using a cardboard diaphragm to diminish the aperture of the mirror.

movable model to illustrate the law of sines.

Cut three strips of cardboard $\frac{1}{2}$ in. wide \times 7 in. long (A, B, & C), two strips 9 in. long (D, E), one 10 in. long (F), and one 17 in. long (G). At $\frac{1}{2}$ in. from each

end of each strip make fine hole. On sheet of stout cardboard 21 in. \times 13 in. describe a circle 6 in. radius, the centre being 9 in. from one end of board. To centre of circle hinge the two strips A and B, by passing twine through one of the holes in each strip and through board, knotting closely on both sides. To free end of A similarly joint D, and to free end of B joint E. Through centre of the circle draw a diameter produced both ways, parallel to length of card. To free end of D joint both C and G, jointing the free end of C to the board at a distance of 8 in. from the centre on the diameter produced. To the free end of E joint F, and at a point on it 6 in. from E joint it to the board at a point 8 in. from centre of circle on diameter produced. Joint free end of F to free end of G. Cover model with two half-sheets of cartridge paper so as to allow only the slips A and B and portions of D and E representing sines to be seen. Draw circle 8 in. radius on paper with two diameters at right angles. The lower half of the circle may be coloured to indicate denser medium. If preferred the strips may be made of sheet zinc, and joints rivetted with brass wire.

Determine index of refraction of water.

Graduate slip of glass about 8 c.m. by 1 c.m. to m.m. Fix with sealing wax, two equal slips about 4 c.m. long at right angles to scale thus—



Place in water so that uprights are just below surface. Fix an eye tube (blackened inside) at some distance above water and in line of scale, and note division at which top of nearest upright appears on scale. Now carefully withdraw water without disturbing apparatus and again note division. Let height of upright be H , and distances on scale from upright respectively a and A , then $\frac{A}{H} = \text{tangent of}$

angle of incidence and $\frac{a}{H} = \text{tangent of angle of refraction}$. From tangents calculate sines, using formula—

$$\text{sine } \theta = \frac{\tan \theta}{\sqrt{1 + \tan^2 \theta}}$$

$$\text{Index of refraction} = \frac{\text{sine of angle of incidence}}{\text{sine of angle of refraction}}$$

Verify result by varying angles.

Make bisulphide of carbon lens.

Grind two watch-glasses on sheet of glass with fine emery and turpentine so that their edges come into perfect contact when placed together. Cut notch in edge of each so as to leave small hole for introduction of liquid. Fasten together with glue or isinglass dissolved in acetic acid. When thoroughly set fill with bisulphide, leaving small bubble of air to allow for expansion of liquid. Cover hole with small piece of paper glued on.

Show influence of surrounding medium on properties of a lens.

Blow three glass bulbs, as spherical as possible, on three pieces of tubing. Fill one with water, one with alcohol, and the third with bisulphide of carbon. Partly fill three small glass beakers with same fluids. Place the beakers on piece of printed paper; immerse each bulb successively in each liquid. Looking through the bulb at print, observe whether image be magnified or diminished.

Determine focal length of a convex lens.

(a) On one side of the lens place a light, on the other a white screen at such a distance that a clear image of the light is formed upon it. Taking a and b as the

distances of the light and the image from the lens, and f the required focal length, then—

$$f = \frac{ab}{a+b}$$

- (b) When the size of the image is the same as that of the object, both the image and the object are at a distance from the lens of double the focal length. The object will be best obtained by cutting two slits in cardboard or scratching them on smoked glass at measured distance from each other; the image may then be focussed on card with distance marked on it.

Make glass cell.

Take three strips of plate glass $\frac{1}{4}$ in. thick by $\frac{1}{2}$ in. wide; two being 4 in. long and one $3\frac{1}{2}$ in. Cement temporarily together by a little marine glue. Grind edges flat and at right angles to the surface on sheet of emery paper laid on flat board and moistened with turpentine. Separate and clean strips. Gently warm and smear edges with marine glue. Grind edges of two pieces patent plate glass $4\frac{1}{4}$ in. by $3\frac{1}{2}$ in. Clean and warm carefully to such temperature as to melt marine. Lay one piece of plate glass so heated, glue on flat surface; lay strips in position upon it, and lay second plate on top, pressing together to exclude air between glass and glue. When cold clean off superfluous cement and mount cell on wood base.

Make a bisulphide of carbon prism.

Cut off and grind ends of glass tube about 2 in. long by $\frac{3}{4}$ in. diameter so that planes of ends make an angle of about 60° with each other. Drill hole about $\frac{1}{8}$ in. diameter in middle of tube with hardened point of triangular file and turpentine. Glue pieces of thin sheet glass on ends. Fill with bisulphide of carbon and cover hole with glued paper.

Make a spectroscope.

Make a cardboard tube about $1\frac{1}{4}$ in. diameter and of focal length of lens provided, at one end of which fix slit drawn on blackened glass or made of thin metal; at other end fix lens. Fix tube and prism on board, prism being mounted on cork and placed in position for minimum deviation for line D. Make cardboard cover blackened inside to exclude extraneous light, and having eye hole in suitable position for viewing spectrum.

Observe spectra of sodium, lithium, strontium, calcium, &c., &c., and learn to recognise presence of these metals in a mixture by their spectra.

Place lighted Bunsen burner opposite slit, and 2 or 3 in. distant from it. Heat platinum wire in flame until it ceases to colour it. Dip wire into solution of salt of the metal, introduce wire into flame, at same time observing spectrum. Having familiarised your eye with spectra separately, try mixtures of the salts.

Test by spectroscope, light transmitted through coloured glasses, liquids, &c.

Placing a luminous flame opposite slit and so obtaining continuous spectrum, interpose the coloured glass between slit and flame; observe what portions of spectrum are cut off. Try effect of looking through two or more of the glasses at luminous flame.

Make a water prism.

Bore clean hole $1\frac{1}{4}$ in. diameter in block of wood 2 in. square with centrebit. Bevel off sides of block to angle of about 20° . Cut centre hole square. Make small hole for introduction of liquid. Fix two pieces thin plate glass 2 in. square on side with marine glue. When cold fill with water, leaving small bubble to allow for expansion. Fill up hole with marine glue.

Make a polariscope.

Clean and blacken one side of piece of sheet glass 3 in. by 4 in. Fix it on one half of board 3 in. by 8 in.

with glue, taking care not to injure black on surface. Fix on other half two uprights at right angles to board, one at the end, the other at 2 in. from end, both being of such height as to support a cardboard-tube making an angle of about 34° with the base board. Make cardboard-tube $1\frac{3}{8}$ inches diameter and 6 inches long, and fix on uprights. Make second tube three inches long to fit in upper end. Carefully clean $12\frac{3}{4}$ inch squares of microscope glass and fix in cork so that surfaces of plates are inclined to axis of tube at an angle of 34° . Fix cork in smaller movable tube. Fix glass plate, as stage, on base board between polariser and end of eye tube, at right angles to axis of latter.

Make selenite figures.

Split selenite into very thin films with thin steel blade. Select pieces of suitable colour by polariscope. Cut so as to form figures of desired shape. Lay together or overlapping on piece sheet glass, fastening down with a little shellac varnish applied at parts which are not to be seen. Sketch outlines and rough details on pieces with ink. Cover with second piece sheet glass blackened so as to expose only the figure. Fasten the two sheets of glass together with paper strips glued along margins.

Make specimens of "Toughened Glass" as objects for polariscope.

Heat strip of ordinary glass in flame until it softens, then plunge into hot oil and move about in oil until cooled to temperature of oil. Remove, wipe clean, and examine.

Make and use cell for exhibiting absorption bands, &c., with spectroscope.

Cut ring about $\frac{3}{8}$ inch broad from glass tube about $1\frac{1}{4}$ inch diameter. Grind edges so as to form wedge. Remove small portion of ring from part equally distant from widest and narrowest part of ring. Cement on plate-glass sides with marine glue. Fill cell successively with solutions of some of the following substances:—Permanganate of potash, roseine, picric acid, ammonio-sulphate of copper, blood. Using luminous flame, place cell in front of slit of spectroscope and observe spectrum, moving cell so as to interpose layer of liquid of varying thickness.

Make simple arrangement for obtaining subjective colours.

Fold piece of white cardboard 12 in. by 6 in. in two, like cover of a book. From the doubled card cut out 16 pieces one inch square, so as to make card like a window-sash, the bars being $\frac{3}{8}$ inch wide. Between the folds lay a piece of vividly-coloured tissue paper and hold up to a bright light. After looking steadily for a few seconds the white bars will appear of the colour complementary to that of tissue paper.

To Silver Glass.

Prepare two solutions.

1. Argentic nitrate is dissolved in distilled water, and ammonia added to the solution till the precipitate first thrown down is almost entirely re-dissolved. The solution is filtered and diluted, so that 100 c.c. contain one gramme of argentic nitrate.
2. Two grammes of argentic nitrate are dissolved in a little distilled water and poured into a litre of boiling distilled water. 1.66 gramme of Rochelle salt is added and the mixture boiled for a short time, till the precipitate contained in it becomes grey; it is then filtered hot.

The glass having been thoroughly cleaned with (1) nitric acid, (2) water, (3) caustic potash, (4) water, (5) alcohol, and lastly distilled water, is to be placed in a clean glass or porcelain vessel, the side to be silvered being placed uppermost. Equal quantities of the two solutions are then to be mixed and poured in so as to cover the glass. This should be done while the glass is still wet with distilled water. In about an hour the silvering will

be completed. Then pour off the exhausted liquid, carefully remove glass, wash in clean water, rub off silver deposited where not required, allow to dry, and varnish silvered side with any thin varnish which does not contract much in drying. The time required for the operation depends on temperature. If the solutions be warmed to about 30° C. the silver is deposited in a few minutes; but it is safer to use them cold. The insides of test-tubes, bulbs, &c., are silvered by putting the solutions into them, no second vessel being then required. *Throughout the whole operation the most scrupulous cleanliness is the grand essential.*

Sound.

Make four paper tubes about 1 inch × 18 inches out of half sheets of cartridge paper; with collars to fit together.

Show that passage of a wave of compression along tube does not produce transfer of matter.

Place small glass flame opposite to end of long tube, allow a little smoke from brown paper to enter tube; clap books together at other end; flame will be extinguished but smoke not ejected.

Try effect of tube in conveying sound.

Join up tubes into long one, place ear at one end, watch at the other; remove tube and ascertain if watch audible at same distance.

Obtain evidence of reflection of sound.

Join your four tubes so as to make two. Place them at a slight angle with each other. Place watch at one end of one tube and ear at adjoining end of other; if watch heard, increase angle between tubes till unheard. Now place card reflector at far end of tubes and adjust till ticking again heard.

Show that sound is reflected by heated air.

Use flat gas flame so that hot air rising from it acts like card in preceding.

Show that as long as continuity of the air is preserved sound passes freely, but is stopped and reflected by thin layer of water.

Place two tubes thus A—B—C, a watch being at A, ear at C, and several folds of a handkerchief or piece of muslin at B. The watch being audible thus, wet one or two folds of the handkerchief and try again.

Try conduction of sound through water.

Beaker of water on sounding box, cork on fork, fastened with sealing wax. Sound fork and touch water with cork.

Try conduction through wood, and iron.

As preceding, with wood or iron rod instead of water.

Make a monochord.

Stout board 3 feet long, 4 inches wide. At 1 inch from one end and 1 inch apart, make holes for, and screw in, two iron screws, leaving heads about $\frac{1}{8}$ inch above board; holes to be so bored that heads of screws are slightly inclined towards end of board. In corresponding positions at other end of board fix small brass pulley and iron rest pin, both at an angle of 45 degs. The pulley is to be near enough to end of board to allow a wire hanging over it to hang freely; the rest pin to fit hole so that it may be turned stiffly with key. Cut two hard wood bridges 1 × 1 × $\frac{3}{4}$ in. for each wire. Twist loop on end of steel wire about 3 feet 6 inches long and slip over head of screw on board, pass other end through rest pin. Place similar wire on other screw and over pulley, making loop at pulley end for hanging weights. Place bridges in position equidistant from ends of board and 30 inches apart. Make paper scale 30 inches long, divided into $\frac{1}{4}$ inches and fix on board between bridges. Make two hard wood movable bridges, higher than the end ones.

Verify the laws of the transverse vibrations of strings.

(a.) Concerning the length of the string.

Measure off $\frac{8}{9}$, $\frac{4}{5}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{1}{2}$, $\frac{2}{5}$, $\frac{1}{3}$ of your monochord wire. Letter these intervals D, E, F, &c. Alter the tension of your string till it is in tune with the tuning fork given you. Now place the bridge successively at the intervals above named, vibrate the string and observe the sequence of notes. Inasmuch as the vibration number is inversely as the length of the string—and the above numbers are the inverse ratio of the vibration numbers of the gamut, the notes you obtain ought to be the notes of the gamut. Verify by comparing notes with tuning forks of different pitch.

(b.) Concerning the diameter of the string.

Stretch two wires on monochord, one (A) strained by weight, the other by pin; tune to unison. Now substitute thicker wire (B) for the one strained by weight, straining it by same weight. Shorten length of other wire until the two are in unison. The pitch being inversely proportional to diameter,—

$$\frac{\text{Length of B}}{\text{Length of A}} = \frac{\text{Diameter of A}}{\text{Diameter of B}}.$$

Verify by weighing equal lengths of A and B, diameter being proportional to square root of weight.

(c.) Concerning the tension of the string.

Tune two wires to unison, one being stretched by smallest weight that will give a clear note. Increase stretching weight to various degrees, ascertaining alteration of pitch by moving bridge of fixed wire until wires in unison. The pitch is proportional to the square root of the stretching weight, e.g. if weights as 4 : 9, pitch will be as 2 : 3. Vary by calculating weights required to suit certain alteration of length and verifying.

(d.) Concerning the weight of the string.

Tune two steel wires to unison. Substitute brass wire for the one stretched by weight, using same weight. Alter length of fixed wire until wires in unison. The pitch being inversely proportional to the square root of the weight of the string, calculate relative weights of the two wires and verify by weighing.

Solve practically by means of the monochord the following problems:—

- Weigh pieces of metal of unknown weight.
- Pitch of one tuning fork being known, ascertain that of another (unknown).
- Diameter of a German silver wire being known, ascertain its specific gravity.

Demonstrate the existence of harmonics on a vibrating string.

Pluck string at 30, damp lightly with feather or blotting paper at 60, note development of octave. Obtain fifth above by plucking at 60 or 20 and damping at 40 or 80. Similarly test for other overtones.

Examine motion of a tuning fork.

- Suspend little ball of sealing wax by thread, touch with vibrating fork.
- Fix flexible style to fork by soft wax. Blacken sheet of glass over gas flame. Vibrate fork and draw style over glass. Fix with very thin varnish.

Make a tonophant:—A simple method of exhibiting Lissajou's figures.

Soften centre of strip of steel 12 inches long, twist round so that plane of upper half of strip is at right angles to lower. Taper off upper strip, fix silvered bead to top with marine glue and clamp lower end of strip in vice. By raising or lowering strip the various rectangular combinations may be obtained.

Obtain Chladni's figures on square and round brass and glass plates. Transfer figures to gummed paper.

Cover a sheet of tea paper evenly with gum. Lay gummed side on sand figure, gently press paper,

remove and dry carefully. Clean plate after each experiment.

Show existence of nodes and vibrating segments on a bell.

- (a.) Obtain fundamental note by bowing bell, damping at one-eighth of circumference from bow. Suspend small sealing wax or pitch balls lightly touching outer edge of ball at various places.
- (b.) Fill bell about two-thirds with water and bow, damping at various points, so as to obtain fundamental note and harmonics. Observe motion of water.

Show response of two tuning forks.

- (a.) Fix tuning fork upright in wood block, strike second fork in unison with it and hold it near but not touching; observe response of hitherto silent fork. Now load one fork with wax and again try; also try two forks of different pitch; note want of reciprocation.
- (b.) Suspend silvered bead by fine thread so that it hangs touching upper part of one prong of the fixed fork. Repeat experiment as above; movement of bead reveals response of fork. For class purposes a shadow of fork and bead may be thrown on screen.

Show response of air to fork.

- (a.) Strike tuning fork and hold it over mouth of phial, pouring in water slowly until maximum resonance is obtained from the air within. Now try a fork of different pitch. Note and measure difference in length of air column. (b.) Try similar experiment with glass jar tuned by water. (c.) Roll up cartridge paper into a tube 1 foot long by 1 inch in diameter, make a second similar cartridge paper tube to slide over the first. Strike fork, hold at end of tube and adjust length of air column till maximum resonance is found. Measure and note this length. (d.) Close one end of a tube and repeat experiment, adjusting as before. Inasmuch as a closed organ pipe yields a note an octave lower than an open pipe of the same length, the length of the closed cartridge tube ought to be one-half that of the open tube.

Determine vibration number of a tuning fork by resonance. Ascertain exact length of closed tube which resounds to fork; this ought to be one-quarter the wave length of fork. Allow for temperature.

Make and use a sensitive flame.

Draw out a piece of $\frac{3}{8}$ ths glass tubing; file contracted end to a V shape: (it is easier to do this when the file is under water). Fix glass tube in clip and attach to gas pipe by flexible tubing. Whistle to the gas flame. Try notes of various pitch. Trim your burner if flame is not sensitive enough. Observe the flame in a moving mirror when under the influence of sound. Try in this way the various vowel sounds on the flame. Note the difference of the images of the flame given in the moving mirror.

Making a singing flame apparatus.

Draw out glass tube 9 inches long, bent at right angles 4 inches from end, fix on block of wood; attach to gas pipe by flexible tubing, using a very small flame. Cut two lengths of glass tubing; one to yield a note corresponding to your fork, the other to its octave. Fixing successively in clip, try each over flame. (Owing to the high temperature of air within the tube, the air column will be found longer than anticipated.)

Tune flame and fork to unison.

Make a paper slider 4 or 5 inches long for each tube. Gradually adjust slider till beats are heard very slowly. Now stop singing flame by momentarily placing finger over top of tube, or if necessary raising tube a fraction of an inch. Strike fork, hold near to, or over tube, and thus start flame. Observe vibration of flame in moving mirror.

Start flame by voice.

Obtain flame on brink of sounding as in last experiment; pitch voice to note given by flame and thus start flame at some distance from it, change note and endeavour to silence flame.

Start singing flame by sympathy with another one.

Tune two singing flames by slider until in perfect unison. Stop singing of both. Start one by slight puff or by fork; the other will sing. Repeat experiment, the flames not being in unison; second flame will not be started.

Determine relative velocities of sound in brass, deal, and mahogany rods.

Clamp rod in middle and vibrate longitudinally with resined leather. Tune monochord wire to unison with each rod successively. The lengths of wire used in each case are proportional to velocities in the rods.

Compare velocities in brass and steel wires.

Stretch the wires on monochord, vibrate longitudinally, altering length of one of the wires till in unison. Lengths of the wires are then in same ratio as velocities.

Compare velocities in brass or wood rod with that in air by means of lycopodium dust.

Rod is clamped by a cork which fits tightly into end of a glass tube at least one inch diameter and as long as whole rod. Free end of rod within the tube has fixed on it a cardboard or cork disc which loosely fits tube. Distribute over inside of tube a little lycopodium powder and vibrate rod longitudinally; the dust will be arranged in little heaps at regular intervals, distances being half-wave lengths. Calling one of these distances l , and length of rod L , $l : L = \text{velocity in air} : \text{velocity in rod}$.

From above experiments draw up a table of absolute velocities in brass, steel, deal, and mahogany.

Determine pitch of tuning fork or organ pipe by means of the syren.

Vibrate fork with violin bow and work bellows attached to syren. When syren and fork nearly in unison beats will be heard, which become slower the more nearly perfect unison is attained; they then disappear entirely. When this occurs throw wheelwork into gear and keep syren in unison with fork for one minute. Throw wheelwork out of gear and read number of revolutions made by disc. This number multiplied by number of holes in disc and divided by 60 gives number of vibrations per second.

Localisation of Arsenic in the Various Tissues of Poisoned Animals.—M. D. Scolosuboff.—The author's method of research has been to dissolve the organic matter in nitric acid mixed with a little sulphuric, to evaporate almost to dryness, to add then a little sulphuric acid, to heat until fumes of sulphuric acid begin to escape, and to add then, drop by drop, pure nitric acid. This being done, it is heated to incipient carbonisation and exhausted with boiling water; the liquid, whilst hot, is treated for a long time with a current of sulphuretted hydrogen, when sulphide of arsenic is deposited. This is transformed by ordinary methods into arsenic acid, which is then transferred to Marsh's apparatus. The poison seems, both in chronic and acute cases, to accumulate specially in the nervous system. The quantity of arsenic found in 100 grms. of fresh muscle being taken = 1; that in the liver is 10.8; in the brain, 36.5; and in the spinal marrow, 37.3. Possibly arsenic is substituted for phosphorus in the cerebral lecithines.—*Bull. de la Soc. Chim. de Paris*,

BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

BRISTOL MEETING.

ADDRESS TO THE MATHEMATICAL AND
PHYSICAL SCIENCE SECTION

BY

Professor BALFOUR STEWART, M.A., LL.D.,
President of the Section.

SINCE the last meeting of the British Association science has had to mourn the loss of one of its pioneers, in the death of the veteran astronomer Schwabe, of Dessau, at a good old age—not before he had faithfully and honourably finished his work. In truth this work was of such a nature that the worker could not be expected long to survive its completion.

It is now nearly fifty years since he first began to produce daily sketches of the spots that appeared upon the sun's surface. Every day on which the sun was visible (and such days are more frequent in Germany than in this country), with hardly any intermission for forty years, this laborious and venerable observer made his sketch of the solar disk. At length this unexampled perseverance met with its reward in the discovery of the periodicity of sun-spots, a phenomenon which very speedily attracted the attention of the scientific world.

It is not easy to overrate the importance of the step gained when a periodicity was found to rule these solar outbreaks.

A priori, we should not have expected such a phenomenon.

If the old astronomers were perplexed by the discovery of sun-spots, their successors must have been equally perplexed when they ascertained their periodicity. For while all are ready to acknowledge periodicity as one of the natural conditions of terrestrial phenomena, yet every one is inclined to ask what there can be to cause it in the behaviour of the sun himself? Manifestly it can only have two possible causes: it must either be the outcome of some strangely hidden periodical cause residing in the sun himself, or must be produced by external bodies, such as planets, acting somehow in their varied positions on the atmosphere of the sun. But whether the cause be an internal or external one, in either case we are completely ignorant of its nature.

We can easily enough imagine a cause operating from the sun himself and his relations with a surrounding medium to produce great disturbances on his surface, but we cannot easily imagine why disturbances so caused should have a periodicity. On the other hand, we can easily enough attach periodicity to any effect caused by the planets, but we cannot well see why bodies comparatively so insignificant should contribute to such very violent outbreaks as we now know sun-spots to be.

If we look within we are at a loss to account for the periodicity of solar disturbances, and if we look without we are equally at a loss to account for their magnitude. But since that within the sun is hidden from our view, it cannot surely be considered blameworthy if astronomers have directed their attention to that without, and have endeavoured to connect the behaviour of sun-spots with the positions of the various planets.

Stimulated, no doubt, by the success which had attended the labours of Schwabe, an English astronomer was the next to enter the field of solar research.

The aim of Mr. Carrington was, however, rather to obtain very accurate records of the positions, the sizes, and the shapes of the various sun-spots, than to make a very extensive and long-continued series of observations. He was aware that a series at once very accurate and very

extended is beyond the power of a private individual, and can only be undertaken by an established institution. Nevertheless each sun-spot that made its appearance during the seven years extending from the beginning of 1854 to the end of 1860 was sketched by Mr. Carrington with the greatest possible accuracy, and had also its heliographic positions—that is to say, its solar latitude and longitude—accurately determined.

One of the most prominent results of Mr. Carrington's labours was the discovery of the fact that sun-spots appear to have a proper motion of their own, those nearer the solar equator moving faster than those more remote. Another was the discovery of changes apparently periodical affecting the disposition of spots in solar latitude. It was already known that sun-spots confined themselves to the sun's equatorial regions, but Mr. Carrington showed that the region affected was liable to periodical elongations and contractions, although his observations were not sufficiently extended to determine the exact length of this period.

Before Mr. Carrington had completed his seven years' labours, celestial photography had been introduced by Mr. Warren De la Rue. Commencing with his private observatory, he next persuaded the Kew Committee of the British Association to allow the systematic photography of the sun to be carried on at their observatory under his superintendence, and in the year 1862 the first of a ten years' series of solar photographs was begun. Before this date, however, Mr. De la Rue had ascertained, by means of his photoheliograph, on the occasion of the total eclipse of 1860, that the red prominences surrounding the eclipsed sun belong, without doubt, to our luminary himself.

The Kew observations are not yet finally reduced, but already several important conclusions have been obtained from them by Mr. De la Rue and the other Kew observers. In the first place the Kew photographs confirm the theory of Wilson that sun-spots are phenomena the dark portions of which exist at a level considerably beneath the general surface of the sun; in other words, they are hollows or pits, the interior of which is, of course, filled up with the solar atmosphere. The Kew observers were likewise led to associate the low temperature of the bottom of sun-spots with the downward carriage of colder matter from the atmosphere of the sun, while the upward rush of heated matter was supposed to account for the faculæ or bright patches which almost invariably accompany spots. In the next place, the Kew observers, making use not only of the Kew series, but of those of Schwabe and Carrington, which were generously placed at their disposal, have discovered traces of the influence of the nearer planets upon the behaviour of sun-spots. This influence appears to be of such a nature that spots attain their maximum size when carried by rotation into positions as far as possible remote from the influencing planet—that is to say, into positions where the body of the sun is between them and the planet. There is also evidence of an excess of solar action when two influential planets come near together. But although considerable light has thus been thrown on the periodicity of sun-spots, it ought to be borne in mind that the cause of the remarkable period of eleven years and a quarter, originally discovered by Schwabe, has not yet been properly explained. The Kew observers have likewise discovered traces of a peculiar oscillation of spots between the two hemispheres of the sun, and finally their researches will place at the command of the observers the data for ascertaining whether centres of greater and lesser solar activity are connected with certain heliocentric positions.

While the sun's surface was thus being examined both telescopically and photographically, the spectroscope came to be employed as an instrument of research. It had already been surmised by Prof. Stokes that the vapour of sodium at a comparatively low temperature forms one of the constituents of the solar atmosphere, inasmuch as the dark line D in the spectrum of the sun coincides in

position with the bright line given out by incandescent sodium vapour.

This method of research was greatly extended by Kirchhoff, who soon found that many of the dark lines in the solar spectrum were coincident with the bright lines of sundry incandescent metallic vapours, and a good beginning was thus made towards ascertaining the chemical constitution of the sun.

The new method soon brought forth further fruit when applied in the hands of Huggins, Miller, Secchi, and others, to the more distant heavenly bodies. It was speedily found that the fixed stars had constitutions very similar to that of the sun. But a peculiar and unexpected success was attained when some of the nebulae were examined spectroscopically. To-day it seems (so rapidly has knowledge progressed) very much like recalling an old superstition to remind you that, until the advent of the spectroscope, the irresolvable nebulae were considered to be gigantic and remote clusters of stars, the individual members of which were too distant to be separated from each other, even with a telescope like that of Lord Rosse. But Mr. Huggins, by means of the spectroscope, soon found that this was not the case, and that most of the nebulae which had defied the telescope gave indications of incandescent hydrogen gas. It was also found by this observer that the proper motions of some of the fixed stars in a direction to or from the earth might be detected by means of the displacement of their spectral lines,—a principle of research which was first enunciated by Fizeau. Hitherto in such applications of the spectroscope the body to be examined was viewed as a whole. It had not yet been attempted to localise the use of this instrument so as to examine particular districts of the sun,—as, for instance, a sun-spot, or the red flames already proved by De la Rue to belong to our luminary. This application was first made by Mr. Lockyer, who, in the year 1865, examined a sun-spot spectroscopically, and remarked the greater thickness of the lines in the spectrum of the darker portion of the spot.

Dr. Frankland had previously found that thick spectral lines correspond to great pressure, and hence the inference from the greater thickness of lines in the umbra of a spot is, that this umbra or dark portion is subject to a greater pressure,—that is to say, it exists below a greater depth of the solar atmosphere than the general surface of the sun. Thus the results derived from the Kew photoheliograph and those derived from the spectroscope were found to confirm each other. Mr. Lockyer next caused a powerful instrument to be constructed for the purpose of viewing spectroscopically the red flames round the sun's border, in the hope that if they consisted of ignited gas the spectroscope would disperse, and thus dilute and destroy the glare which prevents them from being seen on ordinary occasions.

Before this instrument was quite ready, these flames had been analysed spectroscopically by Capt. Herschel, M. Janssen, and others, on the occasion of a total eclipse occurring in India, and they were found to consist of incandescent gas, most probably hydrogen. But the latter of these observers (M. Janssen) made the important observation that the bright lines in the spectrum of these flames remained visible even after the sun had reappeared, from which he argued that a solar eclipse is not necessary for the examination of this region.

Before information of the discovery made by M. Janssen had reached this country, the instrument of Mr. Lockyer had been completed, and he also found that by its means he was able to analyse at leisure the composition of the red flames without the necessity of a total eclipse. An atmosphere of incandescent hydrogen was found to surround our luminary, into which, during the greater solar storms, sundry metallic vapours were injected—sodium, magnesium, and iron forming the three that most frequently made their appearance.

Here we come to an interesting chemical question.

It had been remarked by Maxwell and by Pierce, as the

result of the molecular theory of gases, that the final distribution of any number of kinds of gas in a vertical direction under gravity is such that the density of each gas at a given height is the same as if all the other gases had been removed, leaving it alone.

In our own atmosphere the continual disturbances prevent this arrangement from taking place; but in the sun's enormously extended atmosphere (if, indeed, our luminary be not nearly all gaseous) it appears to hold, inasmuch as the upper portion of this atmosphere, dealing with known elements, apparently consists entirely of hydrogen.

Various other vapours are, however, as we have seen, injected from below the photosphere into the solar atmosphere on the occasion of great disturbances; and Mr. Lockyer has asked the question, whether we have not here a true indication of the relative densities of these various vapours derived from the relative heights to which they are injected on such occasions?

This question has been asked, but it has not yet received a definite solution; for chemists tell us that the vapour densities of some of the gases injected into the sun's atmosphere on the occasion of disturbances are—as far as they know from terrestrial observations—different from those which would be indicated by taking the relative heights attained in the atmosphere of the sun. Mr. Lockyer has attempted to bring the question a step nearer to its solution by showing that the vapours at the temperature at which their vapour densities have been experimentally determined are not of similar molecular constitution, whereas in the sun we get an indication from the fact that all the elements give us line spectra, that they are in similar molecular states.

Without, however, attempting to settle this question, I may remark that we have here an interesting example of how two branches of science, physics and chemistry, meet together in solar research.

It had already been observed by Kirchhoff that sometimes one or more of the spectral lines of an elementary vapour appear to be reversed in the solar spectrum, while the other lines did not experience reversal. Mr. Lockyer succeeded in obtaining an explanation of this phenomenon. This explanation was found by means of the method of localisation already mentioned.

Hitherto, when taking the spectrum of the electric spark between the two metallic poles of a coil, the arrangements were such as to give an average spectrum of the metal of these poles; but it was found that when the method of localisation was employed, different portions of the spark gave a different number of lines, the regions near the terminals being rich in lines, while the midway regions give comparatively few.

If we imagine that in the midway regions the metallic vapour given off by the spark is in a rarer state than that near the poles, we are thus led to regard the short lines which cling to the poles as those which require a greater density or nearness of the vapour particles before they make their appearance, while, on the other hand, those which extend all the way between the two poles come to be regarded as those which will continue to make their appearance in vapour of great tenuity.

Now it was remarked that these long lines were the very lines which were reversed in the atmosphere of the sun. Hence when we observe a single coincidence between a dark solar line and the bright line of any metal, we are further led to inquire whether this bright line is one of the long lines which will continue to exist all the way between two terminals of that metal when the spark passes.

If this be the case, then we may argue with much probability that the metal in question really occurs in the solar atmosphere; but if, on the other hand, the coincidence is merely between a solar dark line and a short bright one, then we are led to imagine that it is not a true coincidence, but something which will probably disappear on further examination. This method has already afforded us a means of determining the relative amount of the

various metallic vapours in the sun's atmosphere. Thus in some instances all lines are reversed, whereas in others the reversal extends only to a few of the longer lines.

Several new metals have thus been added to the list of those previously detected in the solar atmosphere; and it is now certain that the vapours of hydrogen, potassium, sodium, rubidium, barium, strontium, calcium, magnesium, aluminium, iron, manganese, chromium, cobalt, nickel, titanium, lead, copper, cadmium, zinc, uranium, cerium, vanadium, and palladium occur in our luminary.

I have spoken hitherto only of telescopic spectroscopy; but photography has been found capable of performing the same good service towards the compound instrument consisting of the telescope and its attached spectroscope which it had previously been known to perform towards the telescope alone.

It is of no less importance to secure a permanent record of spectral peculiarities than it is to secure a permanent record of telescopic appearances.

This application of photography to spectrum observations was first commenced on a sufficient scale by Mr. Rutherford, of New York, and already promises to be one of the most valuable aids in solar inquiry.

In connection with the spectroscope I ought here to mention the names of Respighi and Secchi, who have done much in the examination of the solar surface from day to day. It is of great importance to the advancement of our knowledge that two such competent observers are stationed in a country where the climate is so favourable to continued observation.

The examination of the sun's surface by the spectroscope suggests many interesting questions connected with other branches of science. One of these has already been alluded to.

I may mention two others put by Mr. Lockyer, premising, however, that at present we are hardly in a position to reply to them.

It has been asked whether the very high temperatures of the sun and of some of the stars may not be sufficient to produce the disassociation of those molecular structures which cannot be disassociated by any terrestrial means; in other words, the question has been raised whether our so-called elements are really elementary bodies.

A third question is of geological interest. It has been asked whether a study of the solar atmosphere may not throw some light upon the peculiar constitution of the upper strata of the earth's surface, which are known to be of less density than the average interior of our planet.

If we have learned to be independent of total eclipses, as far as the lower portions of the solar atmosphere are concerned, it must be confessed that as yet the upper portions—the outworks of the sun—can only be successfully approached on these rare and precious occasions. Thanks to the various Government expeditions despatched by Great Britain, by the United States, and by several Continental nations,—thanks, also, to the exertions of Lord Lindsay and other astronomers,—we are in the possession of definite information regarding the solar corona.

In the first place, we are now absolutely certain that a large part of this appendage unmistakably belongs to our luminary, and in the next place we know that it consists—in part at least—of an ignited gas giving a peculiar spectrum, which we have not yet been able to identify with that of any known element.

The temptation is great to associate this spectrum with the presence of something lighter than hydrogen, of the nature of which we are yet totally ignorant.

A peculiar physical structure of the corona has likewise been suspected. On the whole, we may say that this is the least known—while it is perhaps the most interesting—region of solar research; most assuredly it is well worthy of further investigation.

If we now turn our attention to matters nearer home, we find that there is a difficulty in grasping the facts of terrestrial meteorology no less formidable than that which assails us when we investigate solar outbreaks. The

latter perplex us because the sun is so far away, and because also his conditions are so different from those with which we are here familiar; while, on the other hand, the former perplex us because we are so intimately mixed up with them in our daily lives and actions—because, in fact, the scale is so large and we are so near. The result has been that until quite recently our meteorological operations have been conducted by a band of isolated volunteers, individually capable and skilful, but, from their very isolation, incapable of combining together with advantage to prosecute a scientific campaign. Of late, however, we have begun to perceive that if we are to make any advance in this very interesting and practical subject, a different method must be pursued, and we have already reaped the first fruits of a more enlightened policy; already we have gained some knowledge of the constitution and habits of our atmosphere.

The researches of Wells and Tyndall have thrown much light on the cause of dew. Humboldt, Dove, Buys Ballot, Jelinek, Quetelet, Hansteen, Kupffer, Forbes, Welsh, Glaisher, and others, have done much to give us an accurate knowledge of the distribution of terrestrial temperature.

Great attention has likewise been given to the rainfall of Great Britain and Ireland, chiefly through the exertions of one individual, Mr. G. J. Symons.

To Dove we are indebted for the law of rotation of the wind; to Redfield, for the spiral theory of cyclones; to Francis Galton, for the theory of anti-cyclones; to Buchan, for an investigation into the disposition of atmospheric pressure which precedes peculiar types of weather; to Stevenson, for the conception of barometric gradients; to Scott and Meldrum, for an acquaintance with the disposition of winds which frequently precedes violent outbreaks; and to come to the practical application of laws, we are much indebted to the late Admiral FitzRoy, and the system which he greatly helped to establish, for our telegraphic warnings of coming storms.

Again, the meteorology of the ocean has not been forgotten. The well-known name of Maury will occur to every one as that of a pioneer in this branch of inquiry. FitzRoy, Leverrier, Meldrum, Toynbee, and others, have likewise done much; and it is understood that the meteorological offices of this and other maritime countries are now busily engaged upon this important and practical subject. Finally, the movements of the ocean and the temperatures of the oceanic depths have recently been examined with very great success in vessels despatched by Her Majesty's Government; and Dr. Carpenter has by this means been able to throw great light upon the convection-currents exhibited by that vast body of water which girdles our globe.

It would be out of place to enter here more minutely into this large subject, and already it may be asked what connection has all this with that part of the address that went before it.

There are, however, strong grounds for supposing that the meteorology of the sun and that of the earth are intimately connected together. Mr. Broun has shown the existence of a meteorological period connected apparently with the sun's rotation, five successive years' observations of the barometer at Singapore all giving the period 25.74 days. Mr. Baxendell, of Manchester, was, I believe, the first to show that the convection-currents of the earth appear to be connected somehow with the state of the sun's surface as regards spots; and still more recently Mr. Meldrum, of the Mauritius Observatory, has shown, by a laborious compilation of ships' logs, and by utilising the meteorological records of the island, that the cyclones in the Indian Ocean are most frequent in years when there are most sun-spots. He likewise affords us grounds for supposing that the rainfall, at least in the tropics, is greatest in years of maximum solar disturbance.

M. Poey has found a similar connection in the case of the West Indian hurricanes; and finally, Piazzzi Smyth, Stone, Köppen, and, still more recently, Blanford, have

been able to bring to light a cycle of terrestrial temperature having apparent reference to the condition of the sun.

Thus we have strong matter-of-fact grounds for presuming a connection between the meteorology of our luminary and that of our planet, even although we are in complete ignorance as to the exact nature of this bond.

If we now turn to terrestrial magnetism the same connection becomes apparent.

Sir Edward Sabine was the first to show that the disturbances of the magnetism of the earth are most violent during years of maximum sun spots. Mr. Broun has shown that there is likewise a reference in magnetic phenomena to the period of the sun's rotation about his axis, an observation recently confirmed by Hornstein; and still more recently Mr. Broun has shown that the moon has an action upon the earth's magnetism, which is not altogether of a tidal nature, but depends, in part at least, upon the relative position of the sun and moon.

I must trust to your forbearance if I now venture to bring forward considerations of a somewhat speculative nature.

We are all familiar with the generalisation of Hadley; that is to say, we know there are under currents sweeping along the surface of the earth from the poles to the equator, and upper currents sweeping back from the equator to the poles. We are likewise aware that these currents are caused by the unequal temperature of the earth; they are in truth convection currents, and their course is determined by the positions of the hottest and coldest parts of the earth's surface. We may expect them, therefore, to have a reference not so much to the geographical equator and poles as to the hottest and coldest regions. In fact we know that the equatorial regions into which the trade winds rush and from which the anti-trades take their origin, have a certain annual oscillation depending upon the position of the sun, or, in other words, upon the season of the year. We may likewise imagine that the region into which the upper currents pour themselves is not the geographical pole, but the pole of greatest cold.

In the next place we may imagine that these currents, as far as regards a particular place, have a daily oscillation. This has, I believe, been proved as regards the lower currents or trade winds, which are more powerful during the day than during the night, and we may therefore expect it to hold good with regard to the upper currents or anti-trades; in fact we cannot go wrong in supposing that they also, as regards any particular place, exhibit a daily variation in the intensity with which they blow.

Again, we are aware that the earth is a magnet. Let us not now concern ourselves about the origin of its magnetism, but rather let us take it as it is. We must next bear in mind that rarefied air is a good conductor of electricity; indeed, according to recent experiments, an extremely good conductor. The return trades that pass above from the hotter equatorial regions to the poles of cold, consisting of moist rarefied air, are therefore to be regarded in the light of good conductors crossing lines of magnetic force; we may therefore expect them to be the vehicle of electric currents. Such electric currents will of course react on the magnetism of the earth. Now, since the velocity of these upper currents has a daily variation, their influence as exhibited at any place upon the magnetism of the earth may be expected to have a daily variation also.

The question thus arises, Have we possibly here a cause which may account for the well-known daily magnetic variation? Are the peculiarities of this variation such as to correspond to those which might be expected to belong to such electric currents? I think it may be said that, as far as we can judge, there is a likeness of this kind between the peculiarities of these two things; but a more prolonged scrutiny will of course be essential before we can be absolutely certain that such

currents are fitted to produce the daily variation of the earth's magnetism.

Besides the daily and yearly periodic changes in these upper convection currents, we should also expect occasional and abrupt changes forming the counterparts of those disturbances in the lower strata with which we are familiar. And these may be expected in like manner to produce non-periodic occasional disturbances of the magnetism of the earth. Now it is well known that such disturbances do occur, and further that they are most frequent in those years when cyclones are most frequent, that is to say, in years of maximum sun-spots. In one word, it appears to be a tenable hypothesis to attribute at least the most prominent magnetic changes to atmospheric motions taking place in the upper regions of the atmosphere where each moving stratum of air becomes a conductor moving across lines of magnetic force; and it was Sir William Thomson, I believe, who first suggested that the motion of conductors across the lines of the earth's magnetic force must be taken into account in any attempted explanation of terrestrial magnetism.

It thus seems possible that the excessive magnetic disturbances which take place in years of maximum sun spots may not be directly caused by any solar action, but may rather be due to the excessive meteorological disturbances which are likewise characteristic of such years; on the other hand, that magnetic and meteorological influence which Mr. Broun has found to be connected with the sun's rotation points to some unknown direct effect produced by our luminary, even if we imagine that the magnetic part of it is caused by the meteorological. Mr. Broun is of opinion that this effect of the sun does not depend upon the amount of spots on his surface.

In the next place, that influence of the sun in virtue of which we have most cyclones and greater meteorological disturbance in the years of maximum spots, cannot, I think (as far as we know at present) be attributed to a change in the heating power of the sun. We have no doubt traces of a temperature effect which appears to depend upon the sun period; but its amount is very small, whereas the variation in cyclonic disturbance is very great. We are thus tempted to associate this cyclone-producing influence of the sun with something different from his light and heat. As far, therefore, as we can judge, our luminary would appear to produce three distinct effects upon our globe. In the first place, a magnetic and meteorological effect, depending somehow upon his rotation; secondly, a cyclonic effect, depending somehow upon the disturbed state of his surface; and lastly, the well-known light and heat effect with which we are all familiar.

If we now turn to the sun, we find that there are three distinct forms of motion which animate his surface particles. In the first place, each particle is carried round by the rotation of our luminary; secondly, each particle is influenced by the gigantic meteorological disturbances of the surface, in virtue of which it may acquire a velocity ranging as high as 130 or 140 miles a second; and lastly, each particle, on account of its high temperature, is vibrating with extreme rapidity, and the energy of these vibrations communicated to us by means of the etherial medium produces the well-known light and heat effect of the sun.

Now, is it philosophical to suppose that it is only the last of these three motions that influences our earth, while the other two produce absolutely no effect? On the contrary, we are, I think, compelled by considerations connected with the theory of energy, to attribute an influence, whether great or small, to the first two as well as to the last.

We are thus led to suppose that the sun must influence the earth in three ways, one depending on his rotation, another on his meteorological disturbance, and a third by means of the vibrations of his surface particles.

But we have already seen that, as a matter of fact, the

sun does appear to influence the earth in three distinct ways—one magnetically and meteorologically, depending apparently on his period of rotation; a second cyclonically, depending apparently on the meteorological conditions of his surface; and a third by means of his light and heat.

Is this merely a coincidence, or has it a meaning of its own? We cannot tell; but I may venture to think that in the pursuit of this problem we ought to be prepared at least to admit the possibility of a threefold influence of the sun.

Even from this very meagre sketch of one of the most interesting and important of physical problems, it cannot fail to appear that while a good deal has already been done, its progress in the future will very greatly depend on the completeness of the method and continuity of the observations by which it is pursued. We have here a field which is of importance not merely to one, or even to two, but almost to every conceivable branch of research.

Why should we not erect in it a sort of science-exchange into which the physicist, the chemist, and the geologist may each carry the fruits of his research, receiving back in return some suggestion, some principle, or some other scientific commodity that will aid him in his own field.

But to establish such a mart must be a national undertaking, and already several nations have acknowledged their obligations in this respect.

Already the German Government have established a Sonnenwarte, the mere building and equipment of which is to cost a large sum. With an appreciation of what the spectroscope has done for this inquiry, the first directorship was offered to Kirchhoff, and on his declining it, Herr Vogel has been placed in charge. In France also a physical observatory is to be erected at Fontenay, on an equal, if not greater scale, of which Janssen has already accepted the directorship; while in Italy there are at least three observatories exclusively devoted to this branch of research.

Nor must we forget that in this country the new observatory at Oxford has been so arranged that it can be employed in such inquiries. But what has England as a nation done?

Some years since, at the Norwich Meeting of this Association, a movement was set on foot by Colonel Strange which resulted in the appointment of a Royal Commission on the advancement of science, with the Duke of Devonshire as chairman. This Commission have quite recently reported on the steps that ought in their opinion to be taken for the advancement of scientific research.

One of their recommendations is expressed in the following words:—

“Important classes of phenomena relating to physical meteorology and to terrestrial and astronomical physics require observations of such a character that they cannot be advantageously carried on otherwise than under the direction of Government. Institutions for the study of such phenomena should be maintained by the Government; and in particular an observatory should be founded specially devoted to astronomical physics.”

If the men of science of this country who procured the appointment of this commission, and who subsequently gave evidence before it, will now come forward to support its recommendations, it can hardly be doubted that these will be speedily carried into effect.

But other things besides observations are necessary if we are to pursue with advantage this great physical problem.

One of these is the removal of the intolerable burden that has hitherto been laid upon private meteorologists and magneticians. Expected to furnish their tale of bricks, they have been left to find their own straw. Nothing more wretched can be imagined than the position of an amateur (that is to say, a man who pursues science for the love of it, and is unconnected with any establish-

ment) who has set himself to promote observational inquiries, whether in meteorology or magnetism.

He has first to obtain with great expenditure of time or money, or both, copies of the individual observations taken at some recognised institution. He has next to reduce these in the way that suits his inquiry, an operation again consuming time and demanding means. Let us suppose all this to be successfully accomplished, and a valuable result obtained. It is doubtless embodied in the Transactions of some Society, but it excites little enthusiasm; for it consists of something which cannot be repeated by every one for himself like a new and interesting experiment. Yet the position of such men has recently been improved. Several observatories and other institutions now publish their individual observations; this is done by our Meteorological Office, while Dr. Bergsma, Dr. Neumayer, and Mr. Broun are recent examples of magneticians who have adopted this plan. The publication of the work of the latter is due to the enlightened patronage of the Rajah of Travancore, who has thus placed himself in front of the princes of India and given them an example which it is to be hoped they will follow. But this is only one step in the right direction; another must consist in subsidising private meteorologists and magneticians in order to enable them to obtain the aid of computers in reducing the observations with which they have been furnished. The man of science would thus be able to devote his knowledge, derived from long study, to the methods by which results, and the laws regulating them, are to be obtained; he could be the architect and builder of a scientific structure without being forced to waste his energies on the work of a hodman.

Another hindrance consists in our deficient knowledge as to what observations of value in magnetism and meteorology have already been made. We ought to have an exhaustive catalogue of all that has been done in this respect in our globe, and of the conditions under which the various observations will be accessible to outside inquirers. A catalogue of this kind has been framed by a committee of this Association, but it is confined to the dominions of England, and requires to be supplemented by a list of that which has been done abroad.

A third drawback is the insufficient nature of the present facilities for the invention and improvement of instruments, and for their verification.

We have no doubt advanced greatly in the construction of instruments, especially in those which are self-recording. The names of Brooke, Robinson, Welsh, Osler, and Beckley, will occur to us all as improvers of our instruments of observation. Sir W. Thomson has likewise adapted his electrometer to the wants of meteorology. Dr. Roscoe has given us a self-recording actinometer; but a good instrument for observing the sun's heat is still a desideratum. It ought likewise to be borne in mind that the standard mercurial thermometer is by no means a perfect instrument.

In conclusion, it cannot be doubted that a great generalisation is looming in the distance—a mighty law, we cannot yet tell what, that will reach us, we cannot yet say when. It will involve facts hitherto inexplicable, facts that are scarcely received as such because they appear opposed to our present knowledge of their causes. It is not possible, perhaps, to hasten the arrival of this generalisation beyond a certain point; but we ought not to forget that we *can* hasten it, and that it is our duty to do so. It depends much on ourselves, our resolution, our earnestness, on the scientific policy we adopt, as well as on the power we may have to devote ourselves to special investigations, whether such an advent shall be realised in our day and generation, or whether it shall be indefinitely postponed. If Governments would understand the ultimate *material* advantages of every step forward in science, however inapplicable each may appear for the moment to the wants or pleasures of ordinary life, they would find reasons, patent to the meanest capacities

for bringing the wealth of mind, now lost on the drudgery of common labours, to bear on the search for those wondrous laws which govern every movement, not only of the mighty masses of our system, but of every atom distributed throughout space.

NOTE ON THE DETERMINATION OF MAGNESIA IN DRINKING WATER.

By J. ALFRED WANKLYN.

SINCE the presence of more than a minute proportion of magnesia in water renders water medicinal and unfits it for general domestic use, a rapid method of determining magnesia in drinking water is a desideratum. For this purpose the soap test may be resorted to, and I find that by a very simple and obvious procedure the magnesia may be determined with great rapidity and with sufficient accuracy for the purpose.

My method of procedure is as follows:—

Into a stoppered bottle of the capacity of about a litre, I pour 700 cubic centimetres of the water to be analysed and add 0.5 gramme of finely powdered oxalate of ammonia. The bottle is then shaken for some half-minute, and presently its contents are poured on a filter. The first portions of the filtrate may be rejected, and 70 cubic centimetres of filtrate may then be submitted to the soap test, and the hardness noted down. If the water to be tested be sufficiently free from magnesia, the filtrate after precipitation with oxalate of ammonia should not require more than three soap measures in order to give a very full and durable lather. Waters charged with magnesia, on the other hand, require much more soap test to produce a full and permanent lather. Those chemists who have had much experience with the soap test are familiar with the fact that the hardness due to magnesia is very different in many respects from the hardness due to lime.

It may be useful to point out some of the differences between the behaviour of magnesia and lime towards soap test. In the first place the magnesia hardness, in dilute solutions, is not *equivalent* to the lime hardness. If, for example, a water containing nothing but carbonate of lime be of 13 degrees of hardness it would not be of 13 degrees of hardness if the lime were replaced by its equivalent of magnesia; but it would be of about 19 degrees of hardness. I find namely, on experiment, that whereas one equivalent of lime decomposes one equivalent of soap, one equivalent of magnesia decomposes one and a half equivalents of soap. In concentrated solutions magnesia behaves quite differently towards soap test. Another point to be noted is that a certain lapse of time is required for the production of the magnesia hardness, whilst lime hardness is immediate.

ON CHROME-IRON ALLOY.

By SERGIUS KERN, St. Petersburg.

IN Russia in the Oural Mountains a great amount of chrome-ironstone ($\text{Cr}_2\text{O}_3 \cdot \text{FeO}$) was found during the last ten or fifteen years, so that this ore is very cheap in Russia. In order to find out if it could replace spiegeleisen for the manufacture of steel by Siemens's process, some experiments were made, the results of which are as follows:—

A mixture consisting of

| | Parts. |
|--------------------------|--------|
| Chrome-ironstone | 315 |
| Charcoal powder | 200 |
| Lime | 70 |

was intimately mixed and ignited in a graphite crucible on a coke furnace with a powerful blast for about one hour. On opening the crucible a metallic ingot was

found having a silverish fracture. The analysis of it gave the following average composition of the alloy:—

| | Per cent. |
|------------------------|-----------|
| Chrome | 74 |
| Iron | 25 |
| Foreign matter | 1 |
| | 100 |

The chrome-iron alloy, or as it may be called *chromeisen*, possesses the properties of diamond in regard to its hardness. It cuts glass very easily, and could be used for this purpose instead of expensive diamonds. But this alloy may be used not only for this purpose; it can be a very good and cheap substitute for the spiegeleisen used in Siemens's steel process. Further experiments commenced in one of the Russian steel works will show the fitness of chromeisen in steel manufacture.

CORRESPONDENCE.

ENGLISH WORK.

To the Editor of the Chemical News.

SIR,—I have just read in your columns the interesting address of Mr. Vernon Harcourt to the Chemical Section of the British Association. I regret, however, to find that once more we are treated in this address to the same unjust remarks on English Work in Chemistry which have, on former occasions, been so liberally showered upon us by other eminent and short-sighted professors. These gentlemen judge of the work done in England by the publication known as the *Journal of the Chemical Society of London*. Now, sir, I venture to assert that that periodical does not, and never did, represent one quarter of the work done in England by English chemists.

As regards the importance of English discoveries in science, compared to those made by our continental brethren, let the world judge. Let us only cast our eyes over the voluminous original writings of Frankland, Faraday, Herapath, Graham, Calvert, Stenhouse, Field, Phipson, Wright, Perkin, Gladstone, Crookes, Greville Williams, Maxwell Simpson, &c., to be convinced that our scientific men are second to none in the world. But as regards chemistry there are a greater number of chemical students abroad, because education there is cheaper than with us, and in this country men are trained in greater numbers for the law and the church than for science. Hence, we have had a larger number of distinguished statesmen than of philosophers. After all this may be an advantage. As a rule scientific men do not make good statesmen, whilst a statesman or a lawyer may become an eminent man of science. But to return to chemistry it is very hard that we should be constantly reminded of the small number of scientific chemists working in England, and if it is only done for the sake of drawing more pupils into some particular school or college where chemistry is taught, or as an endeavour to foster chemical study by infusing into it a kind of vapid patriotism, it is a rather paltry way of doing so. Allow us while such remarks are still ringing in our irritated ears to remind our English chemists that whilst going on in their own quiet way they have given to the world the atomic theory, cast steel, and the coal tar colours, besides a few other little details ranging from oxygen to thallium. Indeed, M. Würtz would have been nearer the truth, and more polite, had he modified his little sentence and asserted "*La Chimie est une Science Anglaise*."—I am, &c.,

EQUIVALENT.

Dr. Attfield's Work on Chemistry.—A sixth (illustrated) edition of Prof. Attfield's "Chemistry" will, we understand, be published on October 1.

THE CHEMICAL NEWS.

VOL. XXXII. No. 825.

THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION.*

I.

WHILST our rivals are acting it is a great consolation to know that we are at least talking, and that possibly some day something may be done, unless, as occasionally happens, the subject should be "dropped." At present, far from being agreed as to what should best be done to extend and improve scientific instruction and to advance science, we are not all convinced that anything is needful or that our position is in any way unsatisfactory.

We wish we could accept this last view. No one can deny that the share taken by Britain in the great task of discovery during the past century has been not merely creditable, but splendid. But this—with all due respect to our able correspondent "Equivalent"—is not exactly the question. The real points at issue are these: Are we doing relatively as much scientific work now as in former days? Are we producing in proportion to our population and our opportunities as many discoveries as, say, the Germans? Let us ask how many aliens are now holding professorships or assistantships in chemistry, physics, &c., in our universities, colleges, and higher schools, curatorships in our museums and botanical gardens, or scientific appointments in our manufactories, and, on the other hand, how many British subjects hold analogous positions on the Continent? We fear the latter number would prove almost inappreciable in comparison with the former. "There are a greater number of chemical students abroad because education there is cheaper than with us, and in this country men are trained in greater numbers for the law and the church than for science." Precisely so; and these are some of the very evils of which we complain. Is it necessary, or desirable that the cost of a scientific education should be about five times greater here than in Germany,—a ratio quite out of keeping with the respective cost of living in the two countries? And why are men here trained for the law or the church rather than for science save because the facilities for the latter career are so scanty and its tangible rewards scantier still? Our friend "Equivalent" thinks this excess of lawyers and divines may be an advantage. He holds that "as a rule scientific men do not make good statesmen, whilst a statesman or a lawyer may become an eminent man of science." But we want scientific men to devote themselves to their own department, not to make statesmen, of any sort. It might, however, be desirable that statesmen should more frequently take the advice of men of science, and that when they require such advice they should not expect it to be furnished gratuitously. A statesman or a lawyer may, possibly, become an eminent man of science. So, we must add, may a book-binder or a stone-mason. But in all such rare cases we can only regret that the individual concerned, instead of wasting his time, was not from the first

specially and exclusively trained for scientific pursuits.

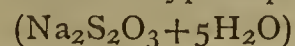
But if we assume it, for the present, that our national position as regards facilities for scientific instruction are not what the necessities of the age demand, our difficulties are only beginning. State aid may shelter and cherish, but it may also cramp and enfeeble. Nay, the possibility is that it may enfeeble without sheltering. We must not, under pretence of fostering chemistry, place chemists under the sway of a "Department," or fetter them, soul and body, in red tape. It might be very well to provide a number of *emeritus* professorships, college fellowships, or the like, where men of proved competence might devote themselves to scientific research, undisturbed by the cares and anxieties of a competitive life. But we know that the noisy, impudent sparrow often contrives to seize the nest of the modest swallow. In like manner we fear that the posts destined for men of science would in most cases be usurped by obtrusive men of the world, or by "pushing" charlatans. At best they would be awarded, not to the most meritorious, but to the partisans of some dominant clique. To afford facilities for the thorough study of chemistry at a reasonable fee would be most beneficial. But if the movement is undertaken, as "Equivalent" puts it, "for the sake of drawing more pupils into some particular school or college where chemistry is taught," or for installing some particular school and its heads as supreme over all others, it is not merely "paltry," but reprehensible. We must beware lest whilst seeking to promote science we merely subserve the personal aggrandisement of Doctor A or Professor B. When the English Government strives to be "paternal" it is exceeding liable to commit some awkward mistake. Any other government, for instance, in seeking a site in its capital for museums and schools of art and science, would have made centrality the first consideration. Our authorities, on the contrary, banish their "*Quartier Latin*" to the remote though fashionable suburb of South Kensington,—a step, to borrow the language of a contemporary, about as rational as to "erect the new Courts of Law upon Bow Common, or to transfer the Bank of England to Hampstead Heath, and the Royal Exchange to Peckham Rye!"

Seeing that the little hitherto done by the state for science includes so gigantic a blunder, we cannot entertain any very sanguine hopes as to the future.

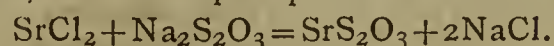
ON THE PREPARATION OF STRONTIUM SULPHIDE.

By SERGIUS KERN, St. Petersburg.

By the following method, strontium sulphide (SrS) is easily received:—Concentrated solutions of strontium chloride (SrCl₂) and sodium hyposulphite—



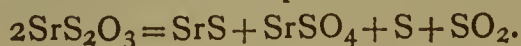
are mixed together; the solution contains, then, sodium chloride (NaCl) and strontium hyposulphite (SrS₂O₃), both soluble salts, so that no precipitate is received:—



The strontium hyposulphite may be precipitated by ordinary alcohol, or, as it was found better, by methyl alcohol (C₂H₄O); the precipitate is washed, dried, and strongly heated. The strontium hyposulphite is then decomposed by the heat, and the remainder is a mixture

* "Sixth, Seventh, and Eight Reports of the Royal Commission on Scientific Instruction and the Advancement of Science." London: Printed for Her Majesty's Stationery Office, 1875.

of strontium sulphide (SrS), strontium sulphate (SrSO₄), and of a small quantity of free sulphur. The following equation represents the decomposition of the salt:—



This mixture is usually employed for demonstrating the phosphorescence of metallic sulphides of alkaline earths, but, for the purpose of obtaining pure strontium sulphide, the following process was found to be the best:—The mass resulting from the heating of strontium hyposulphite is converted into powder and dissolved in water; the strontium sulphide (SrS) remains in solution, and a precipitate is left containing strontium sulphate and free sulphur; the solution is filtered and evaporated on a sand-bath, and the pure strontium sulphide is dried over sulphuric acid.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

(Continued from p. 103.)

How great would be the influence of a cheap source of ozone upon manufactures appears at once from the fact that in the nascent state this body oxidises nitrogen to nitric acid. The presence of the latter body in thunder-rain has long ago been found to result from this circumstance. The manufacture of ozone would, therefore, involve nothing less than the synthesis of this important mineral acid, hitherto only procured from nitre.

That in grass-bleaching and in disinfection by means of ethereal oils we have from time immemorial made use of ozone—generated in the one case by the growth of grass, and in the other by the hydrocarbons—can only serve to intensify our longing for the technical production of ozone. Upon such a process depends the method of bleaching ivory, as it has been conducted since 1850 in Meyer's walking-stick manufactory at Hamburg, and subsequently at other places. The ivory is immersed for weeks in photogen, or other volatile oils, exposed to strong sunshine and to air, whereby the latter is ozonised and bleaches.

The first patent for the application of ozone was recently granted in England. In order to form acetic acid from alcohol without fermentation, the inventors† obtain ozone by blowing air through a flame and bringing it in contact with a current of alcohol. A practical verification of the procedure has not been furnished.

Hydrogen.

Of the three properties to which the industrial applications of hydrogen are applicable two are of so striking a nature that they cannot have escaped the earliest observers. To them it appeared as the combustible principle, the "volatile sulphur;"‡ subsequently, it was regarded as the long-sought-for phlogiston,|| or as the "inflammable air," of which all combustible gases were mere varieties. In modern times, this previously vague knowledge has been rendered definite, recognising in hydrogen the greatest heat of combustion, and consequently the property of producing the highest degrees of heat and light, properties which met with a practical application at an early date.

The low specific gravity of hydrogen did not escape the earliest observers. Being scarcely ponderable, it excited the idea of imponderable bodies, and its specific lightness, as well as its great heat of combustion, soon met with a striking application.

A third attribute is of a less manifest nature. Occasionally destroying colours, but often obtained without any brilliant and striking phenomena, hydrogen in its nascent

state is capable of entering into many combinations, of which it is incapable when pre-existing in a free state. It liberates chlorine, oxygen, and other elements from their compounds, and takes their place; or it is deposited in compounds not fully saturated, and fills up the vacancies. This attribute is most weighty for the most recent development of chemistry, as well as of great technological importance. Unawares, this property has been made use of for ages. Upon it depends the transmutation of indigo-blue in the vat into indigo-white, and, consequently, one of the oldest and most important branches of the art of dyeing.

(To be continued.)

ON THE OXIDATION OF THE ESSENTIAL OILS. PART III.—THE LIMITED OXIDATION OF TERPENES AND CYMENE.*

By CHARLES T. KINGZETT, F.C.S., &c.

PARTS I. and II. of this research have been communicated to the Chemical Society, and will be found in the *Journal* of the Society (series 2, vol. xii., p. 511; and vol. xiii., p. 210).

The research was originally undertaken to demonstrate the nature of that active principle which was known to accompany the oxidation of oil of turpentine.

Schönbein and Berthelot and others had previously worked largely on the subject, but the nature of the principle formed was not determined correctly by either of these observers.

In my previous papers I have given the evidence on which I base my conclusion: that in the atmospheric oxidation of turpentine there results an additive compound which may be camphoric peroxide, and that this body, on coming in contact with water, splits up into peroxide of hydrogen and camphoric acid, thus:—



Peroxide of hydrogen and camphoric acid were both determined to be present in quantity, and each body was established by analytical numbers. But the *relative* quantitative determination of these two substances was not effected, for want of material.

Among other results, I gave figures illustrative of the absorption of oxygen by other essential oils, and showed that peroxide of hydrogen also resulted when water was present.

This paper, which is to be regarded as preliminary in a great measure, contains the results I have obtained in generalising the above method of experiment to the various isomeric and polymeric terpenes, and the results of the limited oxidation of cymene. I defer the conclusions I have been led to, as to the constitution of these bodies, to a later stage in the paper, and will pass on to give the evidence I have obtained bearing on this matter.

Oxidation, by Air, of Terpenes of Formula C₁₀H₁₆.

(I). *Hesperidene*.

The sample experimented with was obtained by Dr. C. R. A. Wright in his researches, and kindly presented to me, with various other terpenes, &c., for these experiments.

One hundred c.c. were exposed, with an equal volume of water, to sunshine during nearly three weeks; meanwhile the terpene acquired a yellow colour, and there resulted a strongly acid solution containing acetic acid, as determined by the ordinary tests and peroxide of hydrogen. This last was determined by titrating the iodine liberated from potassic iodide, by means of hyposulphite. The total quantity contained was 0.154 grm. H₂O₂.

The residual terpene, placed with fresh water and oxi-

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Turner and Vanderpool, *Ber. Chem. Ges.*, vi., 1553.

‡ Lemery, "Mémoires de l'Académie," 1700.

|| Cavendish, 1766.

* A Paper read before Section B, British Association, Bristol Meeting.

dised by a current of air at about 50° C., grew much redder in colour, and developed several successive quantities of peroxide of hydrogen, which were determined.

At the conclusion of this experiment a search was instituted for any acids that may have been produced.

The whole mixture was treated with soda solution, filtered, and treated with acetic acid, which gave a tarry precipitate and a mother-liquor.

(a). The *precipitate* was washed and entirely dissolved in alcohol, giving a solution which gave no precipitate with alcoholic lead acetate. The main portion of the alcoholic solution was evaporated to dryness, residue taken up with water and soda to neutrality, and filtered. The filtrate gave good precipitates with sulphate of copper and nitrate of silver, the latter being reduced on heating.

(b). The *mother-liquor* was exactly neutralised by pure soda, and precipitated by sulphate of copper in the cold. The precipitate, after washing, and when dried at 100° C., contained 12.85 per cent of copper.

It is thus shown that, by atmospheric oxidation of hesperidene, peroxide of hydrogen is formed, along with acetic acid and other bodies which I was not able to determine for want of material.

Wright has shown (*Fourn. Chem. Soc.*, series 2, vol. xi., p. 549) that hesperidene yields, on oxidation with nitric acid, hesperisic acid ($C_{20}H_{26}O_{17}$).

(2). *Myristicene*.

(a). Before experimenting with the terpene of oil of nutmeg, the oil itself was oxidised atmospherically, and it was found to develop, in the presence of water, peroxide of hydrogen, and at the same time the oil became yellow and viscid.

About 200 c.c. of oil of nutmeg was employed, and yielded a solution which was unmeasured, but contained, after some exposure, 0.098 grm. H_2O_2 in 100 c.c.

(b). The terpene from nutmeg oil, by sodium treatment and fractional distillation, and having a boiling-point of 164° C., was next experimented with. This has been shown by Wright to consist essentially of terpene, containing persistently a trace of cymene. Thirty c.c., exposed with 60 c.c. of water to sunshine, gradually oxidised, the oil growing yellow and thick, and a solution resulting of an acid nature and containing peroxide of hydrogen at the rate of 0.0915 grm. H_2O_2 in 100 c.c.

It is to be remarked that this determination was not made until after the lapse of several weeks, hence some peroxide that formed may have been decomposed again.

(c). In the next experiment, the material operated upon was that fraction of the hydrocarbons derived from oil of nutmeg boiling at 173° to 175°, and, as Wright suggests in his paper, probably cymene. About 20 c.c., exposed during thirty days with about 40 c.c. of water to sunshine, gave a solution which ultimately was acid and contained at the rate of 0.0114 grm. H_2O_2 in 100 c.c. The oil had become more yellow and thick.

Wormwood.

In this experiment the ordinary oil of wormwood was used, and was originally of a reddish yellow colour. It likewise, on atmospheric oxidation in the presence of water, yielded a thick residual oil of peculiar camphor-like odour, and gave a solution containing peroxide of hydrogen.

Although the latter was only once determined, viz., at the completion of the experiment, yet, judging by comparison tests, much of the peroxide had become decomposed in some manner during standing.

Eventually, 100 c.c. of the aqueous solution took but a few c.c. of the hyposulphite solution; but it must be borne in mind that Wright (*Fourn. Chem. Soc.*, vol. xii., p. 317) has shown wormwood to consist mainly of an oxidised body, viz., $C_{10}H_{16}O$, although it contains some terpene.

Citronella.

This oil failed to develop any peroxide of hydrogen, even if the exposure continued over several weeks. This

result I expected, knowing that Wright found this oil to consist of an oxidised body, $C_{10}H_{18}O$, and containing no free terpene.

Yhlang, Yhlang.

A sample of this oil perfume was kindly given to me by Mr. C. H. Piesse, who was engaged in some experiments upon it at the time.

Having no knowledge of its constitution, I exposed it with water to air and sunshine during a protracted period, but no peroxide of hydrogen was formed.

I have since met with an account of the constitution of this oil, by Mr. H. Gil (*Year-Book of Pharmacy*, 1874), who gives its sp. gr. as 0.980 at 15° C., and a boiling-point of 160° to 300° C. He failed to find any terpene, but discovered benzoic acid in it. These results were likewise obtained by Mr. Piesse.

The absence of a terpene in the oil strikingly accords with the non-production of peroxide of hydrogen when it is atmospherically oxidised.

Finally, in relation to this part of my subject, I will only add that the oils of caraway, bergamotte, juniper, cubebs, lemon, and chamomile likewise absorb oxygen from the air, forming, when water is present, peroxide of hydrogen; but I will not say to what extent this is the result of the oxidation of the essential terpenes, as admixture with turpentine (a not uncommon practice with druggists) would destroy the conclusions to be drawn otherwise.

Oxidation by Air of Bodies of Formula $C_{15}H_{24}$.

Clove Terpene.

Professor A. H. Church (*Fourn. Chem. Soc.*, series 2, vol. xiii., p. 113) has shown that English oil of cloves contains a terpene, so-called, of $C_{15}H_{24}$ formula. This formula is supported by the vapour density of the body, viz., 7.05 (or 102 if $H=1$), and a boiling-point of 253.9° (after cohobation over metallic sodium, and by re-distillation); also by its sp. gr., viz., 0.905.

It was with a portion of the terpene isolated by Church that the following experiment was performed:—Twenty c.c. exposed with 2 volumes of water to air and sunshine during a period of four weeks failed to give even a trace of peroxide of hydrogen, neither did it alter in character, apparently, beyond acquiring a slight yellow colour. The aqueous solution was examined daily for peroxide of hydrogen.

Patchouli.

This was a sample of patchouli which, when presented to me, was described as having been subjected to a current of air until it became a thick, reddish, transparent body, of a peculiar camphor-like odour.

It failed to give any peroxide of hydrogen with water, or on renewed or prolonged exposure to air and sunshine.

Oxidation by Air of Cymene from various sources.

(a). The cymene first examined was derived from camphor by the action of zinc chloride. I showed, in Part II. of these researches, that 7 c.c. of this product absorbed 52 c.c. of oxygen in eighteen days, and in so doing developed peroxide of hydrogen.

This observation was confirmed by exposing a fresh portion to air and sunshine, by which means a dilute solution of H_2O_2 was obtained.

(b). The cymene next worked upon was kindly presented by Dr. C. R. A. Wright, whom I beg to thank for his kindness. It was derived from dibromide of cajeputol, and boiled at 176° to 177°.

By exposure of 60 c.c. with 2 or 3 volumes of water to air or sunshine an acid aqueous solution was obtained, which after three weeks contained, in 100 c.c., 0.196 grm. H_2O_2 .

I was induced here to seek for α toluic acid, from considerations I shall state hereafter.

The aqueous solution required 30 to 40 drops of soda solution to neutralise its free acid, and the solution so obtained was of a brownish colour, giving a precipitate which seemed somewhat crystalline and partly white

(partly viscid) with hydrochloric acid. The mother-liquor was decanted, and the precipitate re-dissolved in soda and re-precipitated by hydrochloric acid, and the mixture distilled. Evidence was obtained of the presence of an acid having the characters of para-toluic acid in the distillate.

The cymene which had resulted after the oxidation experiment described was further oxidised by a current of air, in the presence of water, at about 40° C., by which more peroxide of hydrogen was produced in small, but estimable, quantities. Finally, the whole mixture was treated with pure potash, and, after agitation, filtered from the residual brown oil.

The filtrate was now concentrated by evaporation and treated with hydrochloric acid in slight excess, thereby producing a considerable precipitate in crystalline masses (needles). These were isolated, washed with cold water, and dissolved in alcohol (readily soluble), and the alcoholic solution treated with ammonia, the excess of which and the alcohol were driven off by heat.

The filtered, but still slightly coloured, solution had the characters of a toluic acid. With cupric sulphate, it gave a bulky precipitate soluble in ammonia. With argentic nitrate, it gave a white precipitate soluble in boiling water, and re-precipitated on cooling.

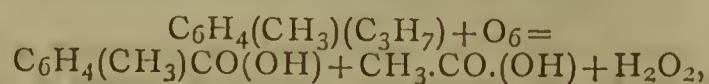
(c). The foregoing observations were repeated on a third specimen of cymene, with similar results, but in neither case did the matters obtained allow of the prosecution of analysis, being too small in quantity.

To recapitulate, I have here shown that, in the limited oxidation of terpenes, represented by the formula $C_{10}H_{16}$, peroxide of hydrogen is invariably obtained, while from such bodies of $C_{15}H_{24}$ formula as I have examined no peroxide of hydrogen results. This seems to indicate that the carbon exists in the $C_{15}H_{24}$ terpenes in an allotropic condition—a condition, by the way, it does not seem hard to bring about.

Bodies of $C_{20}H_{32}$ formula I have not yet examined. If it eventually proved that all bodies of $C_{15}H_{24}$ and $C_{20}H_{32}$ formulæ failed to develop peroxide of hydrogen by limited oxidation, it would constitute a most important and interesting diagnosis. The fact that cymene yields peroxide of hydrogen by this method is another proof that this body is the nucleus of the terpenes, and there is thus established another link between the terpenes and the benzene series.

Wright, Paterno, Fittica, and others have, by their researches, proved the identity of cymene from all sources, and attempts have been made to transform cymene into turpentine. Thus, Guareschi (*Journ. Chem. Soc.*, series 2, vol. xii., p. 684, from *Gazzetta Chimica Italiana*, vol. iii., pp. 545 to 550) attempted this conversion by means of nascent hydrogen; and, although he did not succeed, yet it will doubtless be done before much time shall elapse.

Terpene being the dihydride of cymene, and cymene, as shown by Fittica (*Deutsch. Chem. Ges. Ber.*, vol. vii., pp. 323 to 325), being normal propyl-methyl-benzene, in which the methyl and propyl occupy the *para* position, then, writing cymene as $C_6H_4(CH_3)(C_3H_7)$, its atmospheric oxidation may, perhaps, be represented by—



thus obtaining toluic and acetic acids and peroxide of hydrogen; while, when stronger oxidants are employed, the toluic acid becomes terephthalic acid, and hydric peroxide is not formed.

These results raise many points of the greatest importance regarding the constitution of these hydrocarbons. I hope, at a future time, to be enabled to continue these researches and to elaborate certain views which the foregoing results present to my mind.

Finally, I would point out the views of M. Berthelot (*Comptes Rendus*, vol. lxxix., pp. 1435 to 1442) as to the use of mild oxidants in studying the constitution of hydrocarbons. They are not his peculiar views; many chemists endorse them, and, indeed, I commenced my research on turpentine with somewhat similar convictions.

In the limited oxidation of hydrocarbons, he regards them as constituted of so many groups of atoms, each offering a point from which an oxidising effect can start. Thus, in the case of amylene, Berthelot considers the production of valeric acid, not as a stage in the formation of the more oxidised acids, but as a product from one particular group, amylene having five carbon groups.

It gives me pleasure to acknowledge much kind help I have received from Mr. E. L. Cleaver during the progress of these experiments.

Perhaps I may be excused for dwelling for one moment on the transformation of terpene into terebene by the action of sulphuric acid. Terpene, having a formula of $C_{10}H_{16}$, is a member of the C_nH_{2n-4} series, and yields, as we have seen, peroxide of hydrogen when oxidised under given conditions. Terebene, however, is represented by the formula $C_{20}H_{32}$, which is no longer a member of the above series, but of a series C_nH_{2n-8} . I venture to express a belief that terebene will not yield peroxide of hydrogen when oxidised in the way I have described; and, if this proves true, it would support the conclusion to be inferred from its formula, viz., that the carbon exists in an allotropic condition.

SOCIETY OF PUBLIC ANALYSTS.

"PIPER NIGRUM."

By A. WYNTER BLYTH, M.R.C.S., F.C.S., &c.,
Analyst for Devon.

BLACK pepper is the dried *immature* fruit of *Piper nigrum*, one of the Piperaceæ, or pepperworts. The pepperworts are a well defined natural order, confined to the hottest parts of the world, and delighting in low places, valleys, and the banks of rivers. Although neither the number of its genera nor of its species is great, yet the whole order is remarkable for a variety of active and useful plants,—*e.g.*, the aromatic black and long peppers, the astringent matico, the intoxicating *Macropiper methysticum*, the different varieties of cubebs useful in the treatment of inflamed mucous membranes, and several other plants possessing medicinal properties,* belong to the natural order Piperaceæ.

Black pepper itself is a climbing plant, attaining the height of from 8 to 12 feet; the berries—or, botanically speaking, "drupes"—are at first green, then red, and, if left still longer ungathered, turn to black; but before this latter change takes place the berries are gathered by hand and dried in the sun,—the result being an entire change of appearance; instead of a red, smooth berry, a black or reddish black peppercorn, with the cortex contracted and shrivelled in such a manner as to form a veined network, is obtained. The plant is cultivated in various portions of the equatorial regions of the earth, the zone of cultivation being confined to the isotherms of 82°: it would not, however, be strictly correct to say that this high mean annual temperature was essential, or even necessary; for the fact is that it is produced principally in the cooler valleys, where the mean annual temperature does not perhaps exceed 70° F.

The black pepper imported into this country principally comes from the islands of Malacca, Java, Borneo, and Sumatra. The commercial varieties are at least five, viz., Malabar, Penang, Sumatra, Trang, and Tellicherry, names indicating the localities from whence they are derived. The differences which these different varieties of pepper present *to the eye* are evident enough when the several samples are at hand for comparison, but it takes a

* The *Artanthe eucalyptifolia*, used in Brazil in case of colic. *Piper parthenium*, used in menstrual disturbances. *Chairca Belle* and *Sirrboa* cause salivation and decrease the function of the skin. Beside these, *Acrocarpidium hispidulum*, *Coccobryon capense*, *Artanthe adunca*, *Chairca adunca*, and others, possess active and useful properties.

very practiced observer to identify a solitary sample; and if samples of each of the kinds named were mixed together, I doubt the ability of any person, however "*habile*," to separate the berries again, identifying each sort with any correctness. The merchant indeed relies more upon the weight than the appearance; he takes a handful of peppercorns, and by long practice can tell in a moment whether it is a light or a heavy sample. Chevallier has determined the weight of what is technically called heavy, half heavy, and light pepper. A litre of the first weighed 530 grms.; of the second, 512 grms.; of the third, 470 grms. That there is considerable difference in weight in the different berries is certain, for I carefully weighed 100 berries of each kind, with the following result:—

| | Grammes. |
|-----------------------------------|----------|
| 100 peppercorns of Penang weighed | 6.2496 |
| 100 „ „ Malabar „ | 6.0536 |
| 100 „ „ Sumatra „ | 5.1476 |
| 100 „ „ Trang „ | 4.5736 |
| 100 „ „ Tellicherry „ | 4.5076 |

If, then, quality is to be judged of by weight, Penang and Malabar may be bracketed together as standing first, Sumatra holding the second place, and Trang and Tellicherry bracketed together in the third. The general opinion of the trade is, I believe, that Malabar is really the heaviest, and possibly the samples of Penang which I possess are unusually fine. The whole of the ground peppers of commerce are mixtures of different kinds of pepper; there is no such thing to be found in the shops as a pure ground Malabar or a pure ground Penang. The principal varieties mixed for household purposes and retailed are Malabar, Penang, and Sumatra: the first of these is the dearest.

The usual mixture, according to Chevallier,* is—

33 per cent of Malabar to give weight,
33 per cent of Penang to give strength,
and 33 per cent of Sumatra to give colour.

The pepper thus mixed is either ground by the aid of large mill stones, or in an apparatus perfectly analogous to a coffee mill; the latter mode is far preferable to the former, as the friction of the stones develops considerable heat, and dissipates some of the aromatic principles. Pepper thus damaged by the heat of the mechanical operations is technically known as "burnt."

The microscopical structure of the black pepper berry has been accurately delineated and described by Dr. Hassall, and therefore needs no notice, as there is really nothing new to add. There is hardly anything the analyst has to examine which has a more decided and distinct microscopical structure, and all organic adulterations can be detected by a practical observer by the aid of the microscope.

The chemistry of pepper is still in a very imperfect state. Pelletier has recognised and separated piperine ($C_{17}H_{19}NO_3$), a volatile oil ($C_{10}H_{16}$), gum, bassorin, starch, an acrid resin, malic and tartaric acids, salts, extractive, and woody fibre; but there is no quantitative analysis of the whole of the known constituents. The object of this paper is to lay before the Society some observations, a portion of which has already appeared in the CHEMICAL NEWS† and in *Les Annales d'Hygiène*.‡ On (1) the hygroscopic moisture; (2) the ash, its percentage and composition; (3) the nitrate in pepper; (4) the alcoholic; and (5) the aqueous extract.

1. *The Hygroscopic Moisture*.—This was determined by weighing about 1 gramme of the very finely powdered substance and drying in a water-bath in the usual way. Without doubt pepper dried at this heat retains a considerable quantity of water, but the very strong odour which all aromatic substances evolve at 100° C. sufficiently show that volatile principles are, during the whole evaporation, given off; it therefore is very questionable whether it is advisable to dry at a higher heat than 100° C.

* "Du Poivre," par A. Chevallier, *Annales d'Hygiène Publique*.

† CHEMICAL NEWS, October, 1874.

‡ "Etude Chimique sur les poivres du Commerce," par le Dr. A. Wynter Blyth. *Annales d'Hygiène Publique*, July, 1875.

The percentage of moisture is as follows:—

| | |
|---------------------|--------|
| Penang | 9.531 |
| Tellicherry | 12.908 |
| Sumatra | 10.103 |
| Malabar | 10.548 |
| Trang | 11.664 |

The highest percentage, then, is 12.9, the lowest 9.5, the mean of the whole 10.95.

2. *The Ash*.—In the determination of the ash about 2 grammes were placed in a large platinum dish and burnt down at a low red heat, until it was of an equally grey colour and ceased to lose weight; it was then weighed as quickly as possible, the result expressed as total ash; the ash was then dissolved in boiling water, the solution filtered, evaporated down, gently ignited, and the result expressed as soluble ash.

| | Pepper dried at 100° C. | | Pepper as sold. |
|----------------|---------------------------|-------------------------|-------------------------|
| | Soluble Ash. Per cent. | Total Ash. Per cent. | Total Ash. Per cent. |
| Penang .. | 2.212 | 4.189 | 3.843 |
| Tellicherry .. | 3.380 | 5.770 | 5.346 |
| Sumatra .. | 2.626 | 4.316 | 3.334 |
| Malabar .. | 3.453 | 5.195 | 4.674 |
| Trang .. | 2.538 | 4.775 | 4.211 |

In all enquiries of this kind the extreme numbers are those which have the most value—the least amount of ash or the greatest amount of ash ever found in genuine samples. Now the smallest percentage of ash derived from a ground black pepper taken in its undried state that I can give is 3.3 per cent; the greatest amount is 5.3 per cent, and invariably a little more than half of this ash is soluble; it is useful to compare with these numbers those obtained by Dr. Hassall, and published in "Food, Water, and Air."

Whole Black Pepper (HASSALL.)

| | |
|----------|--------------------|
| Sample 8 | Ash 4.03 per cent. |
| 9 | „ 4.33 per cent. |
| 10 | „ 3.90 per cent. |
| 11 | „ 4.61 per cent. |
| 12 | „ 4.01 per cent. |
| 13 | „ 3.67 per cent. |

Thus the greatest percentage of ash given by Dr. Hassall is 4.33 per cent., the lowest 3.9, the mean of the eleven numbers derived from the two sets of independent observations gives us the ash of a genuine black pepper, 4.17 per cent., and the conclusion is inevitable that in no case should a ground black pepper *as sold* give an ash of 5½ per cent. That the ground black peppers of commerce do give very high percentages of ash, and are therefore much adulterated, is evident from the fact that, in 16 samples of ground black pepper examined by Dr. Hassall, only one was under 5 per cent., the percentages of the other fifteen being distributed as follows:—

| | |
|-------|--------------------------------------|
| One | gave between 5 and 6 per cent of ash |
| Three | gave between 6 and 7 „ „ |
| Three | gave between 7 and 8 „ „ |
| Seven | gave between 9 and 10 „ „ |
| One | gave between 11 and 12 „ „ |

Now, if these peppers were properly burnt, as without doubt they were, fifteen out of the sixteen were adulterated.

With regard to the composition of the ash of black pepper, the following is an analysis of the ash of Tellicherry pepper:—

| | 100 grammes of ash. |
|-------------------------|---------------------|
| Potash | 24.380 |
| Soda | 3.226 |
| Magnesia | 13.000 |
| Lime | 11.600 |
| Iron | 0.300 |
| Phosphoric acid | 8.470 |
| Sulphuric acid | 9.613 |
| Chlorine | 7.570 |
| Carbonic acid | 14.000 |
| Sand | 6.530 |

Of all of these constituents, the sand is the most variable. The highest determination of sand which I have as yet met with occurred in a sample of Penang pepper, which gave 9 parts of sand in every 100 of ash; but if we allow that a pepper ash may contain 10 parts in every 100 of sand, how can we account for, on any theory except wilful adulteration, the fact of the ground pepper of commerce yielding to the analyst an ash one-third or one-half of which is very commonly found to consist of sand. The iron, part of which is magnetic, the alkaline earths, the chlorine, the alkalies, all vary somewhat; but there is one constituent which is extremely constant, and may be of technical utility, and that is the phosphoric acid. The phosphoric acid I find to average 8.5 per cent of the ash. I do not believe that it varies more than half a percentage either way; its determination is therefore of some value.

I may here remark that it would be of great physiological interest to bring into one view the varying amounts of phosphoric acid found in these fluids or substances which bear the name or take the place of milk. It must be remembered that the albumen of the seed, the albumen of the egg, and the milk of mammals, though so widely different in their appearance, yet all agree in one thing, that each is destined to nourish, to form materials for growth of the embryo or very young animal or plant; hence, on theoretical grounds alone, it might be predicated that such substances and fluids would be remarkably constant in their chemical composition; and I believe that with regard to seeds generally, published analyses bear this out, the element of variability that some exhibit perhaps residing in the covering portions of the seed, the cortex, and not in the seed proper, that is in the albumen and embryo. However this may be, the amount of phosphoric acid in seeds is so constant that we can hardly allow that it is stored up by mere physical agencies, but that it is the result of a vital selection of the living matter of the seed cells, whilst the lime, the sand, the magnesia, and the iron certainly show sufficient variability to suppose that a portion of these constituents is as it were accidental and not essential. It would also appear that potash or soda may to a certain extent be replaced by each other.

With regard to the arrangement and combination of the different elements found upon incineration there is much to be learnt. That the carbonic acid has no relation whatever, nor is any guide to a knowledge of the amount of carbonates existing as such in the plant, is well known, and may be proved. Thus numerous analyses of pepper ash have given me from 12 to nearly 15 per cent of carbonic acid calculated upon the ash; but pepper itself has very minute quantities of carbonate; for I have finely powdered Malabar pepper, treated it with acid, and placed it in an absorption apparatus connected with an aspirator, and drawn through the solution perfectly dried carbonic acid free air, and found that 100 grammes yielded only 0.657 milligramme of CO₂, or about 0.143 per cent of the ash; hence the 10 or 11 per cent must be produced from the organic salts, &c.

Nitrates and Nitrites in Pepper.—Comparatively few observations of the amount of nitrates and nitrites in organic substances are on record: it is a subject of some scientific interest, especially since it has been observed that nitrates and nitrites are decomposed in the presence of free oxalic acid. Whether the determination of nitric acid will be of service or not to the food analyst is unknown: it certainly may be so, if it be found that a substance rich in nitrates is fraudulently mixed with one poor in nitrates.

| | | Calculated as Nitric Acid |
|---|-------------|------------------------------|
| 100 grms. of undried Penang pepper yield .. | | Gramme. |
| " | Malabar | 0.04470 |
| " | Tellicherry | 0.03858 |
| " | Sumatra | 0.08860 |
| " | Trang | 0.06560 |
| " | | 0.11870 |

The Alcoholic Extract, obtained by exhausting a weighed sample of the dried substance by repeated quantities of boiling alcohol in a flask attached to an inverted condenser, is a fair index of the quality of a pepper, for the extract so obtained consists almost entirely of piperine and resin, the two constituents on which the qualities of pepper almost exclusively depend; nor do I believe that the advantage of separating these constituents sufficiently compensates for the extra trouble and time.

One hundred grms. of the substance dried at 100° C.:—

| | Grammes. |
|---------------------|----------|
| Penang | 7.650 |
| Malabar | 6.375 |
| Sumatra | 6.450 |
| Tellicherry | 7.896 |
| Trang | 6.300 |

The extract, then, varies from 6.3 to 7.8 per cent.

The Aqueous Extract, containing extractive and colouring matter, soluble salts, gum, starch, and small quantities of piperine and resin, was determined by thoroughly exhausting a small weighed portion of pepper by a large quantity of boiling distilled water, and found to vary from 18 to 20 per cent.

One hundred grms. of the dried substance taken:—

| | Aqueous Extract. Grammes. |
|---------------------|------------------------------|
| Penang | 18.335 |
| Malabar | 20.375 |
| Sumatra | 17.500 |
| Tellicherry | 16.500 |
| Trang | 18.175 |

The amount of starch in the five samples is very nearly the same—a fact easily proved by making a decoction of each, of exactly similar strength, decolourising by charcoal, then placing in Nessler cylinders, and adding an equal quantity of iodine to each; the gradations of colour are so faint that there can be hardly the difference of a percentage in the whole five: it is, however, shown in this way that Sumatra has most starch; next in order comes Penang; then Malabar, Tellicherry, and Trang, the last three containing identical quantities of starch.

Adulterations of Pepper.—Pepper has been adulterated for at least two centuries and a half, for Pierre Pomet,* writing in 1614, says:—"As the greatest part of pepper, white as well as black, is sold 'battu' (that is to say, powdered), it should only be bought of honest merchants, because all the pepper the retailers sell is no other thing, for the white, than '*des épices d'Auvergne blanches*,'† or, rather, black pepper whitened with ground rice; the black is only the dust, either of the crust of bread, grey Auvergne spices, or manigette.

The list of the adulterations enumerated by authors is an extraordinary one. Linseed meal, rice, pepper leaves, mustard, wheat flour, sago, woody fibre, chillies, rape-seed, potato, spices, capsicum, manigette (otherwise known as guinea pepper), chicory, rye, powdered leaves of the laurel which have been previously used to wrap round extract of liquorice, the stones from olives, bone dust, marine salt, and various mineral adulterations, are all said to have been selected.

However various may be the adulterations in France where Chevallier tells us in Paris alone he is acquainted with a manufactory producing 12 to 15 hundred kilogrammes annually of a mixture sold solely for the purpose of adulterating pepper, the only common adulterations of this country are what is known in the trade as P.D., H.P.D., and W.P.D., abbreviations for pepper dust, hot pepper dust, and white pepper dust; the first, or P.D., used to be principally composed of the faded leaves of autumn, but linseed meal is now preferred; H.P.D. is

* Pomet, "Histoire General des Drogues," 1735.

† "Depuis un temps immemorial le poivre en poudre sous le nom d'épices d'Auvergne, et compose de pain de cheneirs et de tourteaux de faine et souvent aussi avec de la terre pourrie."—Soubeiran, "Dictionnaire des Falsifications," Paris 1874

chiefly the husks of mustard; and W.P.D. is ground rice. To all these we must add sand, which is most certainly added; whether derived from the sweepings of the shops, or whether added as sand, is not at all clear.

Besides the formidable list of adulterations just given as found in powdered pepper, the berry itself is not free from manipulation, for as the merchant judges by the weight of the sample, means are taken to render the lighter sorts equal in weight to the heavy Malabar and Penang, and in order to do this they are macerated in tubs of brine for 24 hours, and thus impregnated with salt and water find their way into the market as Malabar; but such samples are quickly recognised by the astute merchant, and the high chlorides, the high ash, the great amount of humidity, could hardly fail to reveal their nature to the analyst.

As coffee has been cleverly imitated by chicory pressed into the shape of the coffee berry, so by pressing various pastes into the shape of the pepper berry has pepper been imitated. Of this adulteration there is the most undoubted evidence. Accum noticed artificial peppercorns made of oil cake, common clay, and cayenne pepper, and Chevallier in a recent paper states that in 1843 he was requested to examine a sample taken from 40 bales, in which he found from 15 to 20 per cent. of pepper, composed of pepper dust, bran, and other matters.

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NOTICES OF BOOKS.

A Dictionary of Chemistry. By H. WATTS, B.A., F.R.S., F.C.S. Second Supplement. London: Longmans, Green, and Co. 1875.

THREE years have elapsed since the appearance of the first supplementary volume to the "Opus Magnum" of Mr. Watts. During this interval, the number and the activity of chemical investigators have certainly not decreased. A second supplement has thus become necessary to bring the work up to the standard of the present year. This task, laborious from the involved necessity of examining and collating a vast mass of documents, has been performed by the author and his learned coadjutors in the ablest manner. We would call particular attention to the articles on alizarin, analysis, aniline, colours, anthracen and its allies, atmosphere, benzene, capillarity, cobalt bases, light, and phenol as being admirably digested and condensed summaries of the fruits of recent research.

Under the head of indigo, two analytical methods are

mentioned which were formerly very satisfactory for commercial purposes, but which have been rendered illusory by recent improvements in fraud. The first of these is the determination of the amount of ash present, and the second is the determination of the specific gravity. Both these figures are naturally lower in a genuine sample than in one adulterated with mineral matter. But when farina is used as an admixture, they both fail. In addition to the direct information which it conveys, the work has the additional advantage of serving as a key to chemical bibliography. As an instance of its thoroughness in this respect, we need merely refer to the article on "Water." We are in no fear of contradiction if we pronounce this supplement necessary for every chemist.

American Contributions to Chemistry. An Address delivered on the Occasion of the Celebration of the Centennial of Chemistry. By BENJAMIN SILLIMAN. Philadelphia: Collins.

SCIENCE is not, in its essence, national. The share taken in its development by any one country, separately regarded, is merely a splendid fragment, not an organic whole. We would gladly encourage, indeed, a noble emulation between nations in the extent and the value of their "contributions to chemistry"—or to any other branch of the interpretation of nature. We frankly congratulate America on her part in this great task. But we doubt whether the work before us is an example to be followed. Conflicting and doubtful claims are inevitable. Thus says Prof. Silliman:—"Joseph Priestley's name is immortal in the annals of our century of Chemistry. We are proud to claim him as an American by adoption, and are quite willing to adopt him with all his discoveries. A distinguished French Academician of this century once said, on presenting for the first time to the Academy of Sciences in Paris a memoir on the laws of Ohm respecting electric conduction, 'Truly, Mr. President, this is not a French discovery, but it is worthy to be made such!' So say we of Priestley and the discovery of oxygen; if it was not an American discovery it is worthy to be made such. Whom England cast out with obloquy, we accepted with cordial hospitality."

We cannot subscribe to all that is implied in this passage. That Priestley was an Englishman by descent, birth, and education, and that the bulk of his discoveries were made in England, no one will deny. That he was persecuted we admit; but can modern England be fairly blamed for the aberrations of such men as George III. and Mr. Sugar, sometime town-crier of Birmingham? Priestley was not a "martyr of science." He suffered not on account of his discoveries. Had his life always been "peaceful and philosophic," had he never descended into the dusty arena of theological and political controversy, he would have lived and died unmolested. He was "cast out with obloquy" not by England, but by a rampant party, intoxicated with success and seeking to crush all opposition. Let us put a case to Prof. Silliman. Suppose that during the great American civil war some eminent man of science had sympathised with the south, and had advocated his cause in scores of able pamphlets. Might he not possibly have fared as ill at the hands of a Republican mob as did Priestley at those of the Birmingham roughs? Might he not possibly have been "cast out with obloquy?" Would it in such a case be fair if some European writer a century hence should charge upon America as a whole the misdeed of a party? But further; the hospitality with which Priestley was received in America, unless we are strangely misinformed, was neither unanimous nor uninterrupted. Hostile voices were not wanting, and at one time, it is said, his expulsion from the country was under contemplation, when the current was turned by the election of a new President of more liberal views.

Since, however, as we have already observed, the bulk of Priestley's researches were achieved whilst England

and America were not distinct nations, but were still two provinces of one empire, his fame, like that of Newton, of Bacon, or of Shakspeare is the joint heritage of the new country and the old.

*Contributions to the Knowledge of Alizarin and Oxyanthrachinon.** By CONRAD WILLGERODT. Freiburg: Lehmann.

FROM this inaugural dissertation we extract the following:—

Purification of Artificial Alizarin.—The paste in question is tested in the first place for acids, salts, and for anthrachinon, and these impurities, if present, are removed by well-known methods. For without taking the acidity into account a neutral alizarate can never be obtained, since the saturation of the alizarin with potash is calculated on the dry matter in the paste. If no regard is paid to the anthrachinon, and to the salts possibly present, the alizarin may be easily supersaturated with the calculated quantity of potash, in which case the alizarate of potash cannot be separated by means of alcohol from the potash-salt of oxyanthrachinon, since in presence of an excess of potash the former dissolves in this solvent with a colour bordering on blue.

To separate alizarin and oxyanthrachinon, the paste, previously freed from acids, salts, and anthrachinon is mixed with a calculated quantity of potash, which should previously be dissolved in a little water. The resulting violet-brown mass dried in the water-bath, and finely powdered, is treated with large amounts of alcohol in a flask provided with an upright condenser. An intense blood-red colouration is first obtained. The extraction with alcohol is continued until violet extracts are obtained. The first blood-red solutions are evaporated to dryness separately. The violet liquids are strongly concentrated, when, on cooling, almost all the alizarate of potash is deposited, and only the pure blood-red solution of the potash compound of oxyanthrachinon remains. If this dried compound is dissolved in water and the solution supersaturated with an acid, we obtain a straw-coloured, gelatinous precipitate of oxyanthrachinon. By extracting the potash-compounds with alcohol an approximate quantitative determination of the oxyanthrachinon present as an impurity in the alizarin may be obtained.

The usual method of purifying alizarin, dependent on the solubility of the lime-salt of oxyanthrachinon in water was also employed by the author, and yields pure oxyanthrachinon without difficulty.

The potash compounds of the paste are dissolved in water and the solution is mixed with chloride of calcium in excess. The sparingly soluble alizarate of lime is precipitated, whilst the oxyanthrachinon salt remains in solution if a sufficiency of water is employed. The whole is filtered and the residue is washed with hot water till the alizarate of lime begins to dissolve, which may be recognised by the blue-violet colour of the liquid passing through the filter.

Hence, it appears contrary to the received notion that the lime salt of alizarin is not insoluble in an excess of hot water. The filtrate should, therefore, be allowed to stand for several days till the trace of alizarate of lime has been re-deposited. The solution, which then resumes its yellowish-red colour is then filtered, and treated with hydrochloric acid in excess, when perfectly pure oxyanthrachinon is deposited.

The following passage is important:—

The oxidation which yields alizarin is essentially due to the oxygen of the atmosphere. To prove this the author proposes, at the suggestion of Prof. Claus, to carry on further experiments, passing atmospheric air into the melting mass. He hopes, under suitable circumstances, to convert, not merely oxyanthrachinon, but even anthracen, into alizarin.

The author gives 289°–290° C. as the melting-point of pure alizarin.

* Beiträge zur Kenntniss des Alizarins und Oxyanthrachinons.

CORRESPONDENCE.

THE HISTORY OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—The author of the very interesting articles entitled "Outlines of a Bibliography of the History of Chemistry," which have recently appeared in your columns, has referred to a small contribution of mine to the history of chemistry in the following terms:—

"RODWELL, G. F. *The Birth of Chemistry, in Nature*. vols. vi. and vii., 1872-73. A popular essay full of research, especially rich in the knowledge of the Egyptians. It embraces only the period prior to 1680."

I venture to point out that, although the period prior to 1680 is discussed at greater length than the period intervening between that date and the time of Priestley, Scheele, Lavoisier, and Cavendish, the latter period is touched upon. For the developed theory of Phlogiston and the discoveries of Stephen Hales both belong to a later date than 1680. It is possible that Mr. Bolton has not seen the articles which appeared in *Nature* in their collected form, and may hence not have met with the last of them, which treats in brief of the theory of Phlogiston and Stephen Hales. I wish, indeed, that it were possible to speak of any history of chemistry as being "especially rich in the knowledge of the Egyptians." When we remember that the science originated in Egypt, and that the very name is derived from an Egyptian source, we can but hope that in the progress of Egyptian discovery as valuable information in regard to the history of chemistry as has already been found in regard to astronomy may be brought to light.—I am, &c.,

G. F. RODWELL.

Brancaster, September 6, 1875.

SCIENCE AT THE UNIVERSITIES.

To the Editor of the Chemical News.

SIR,—The admirable address of Prof. Vernon Harcourt to the Chemical Section of the British Association, contained in the CHEMICAL NEWS (vol. xxxii., p. 105), places some points in connection with the advancement of the science in a new and suggestive light; notably his proposal to organise research in scientific chemistry on a similar plan to that of the Pharmaceutical Conference in pharmaceutical chemistry; and it is to be hoped that some such scheme may be devised and carried out, as it is certain to be of great value. It is not my intention to speak at length with respect to the plan just mentioned, but to refer to one or two points in the address which one would fain hope were true, but which enquiry shows to be, at least, not entirely so. I mean his remarks with regard to the position of science at the Universities.

He says (vol. xxxii., p. 105) that the Universities (he instances Oxford more particularly, as being best acquainted with it) have "made liberal provision for the teaching of science," and the colleges have not "been backward in allotting scholarships and fellowships, . . . "but the result is somewhat disappointing, and under a free-trade system science has failed to attract more than a small percentage of University students." He also says of the Universities, further on, that "*with certain reserves in favour of classics and mathematics, their system is that of free trade.*" The italics are mine, and I believe I am in a position to show, for at least two of the Oxford colleges, Merton and Exeter—and I believe it applies to them all—that "free trade" in education is not the rule at Oxford, nor at Cambridge either.

With a view to taking advantage of the scientific teaching of Oxford, I have enquired about Open Natural Science Postmasterships at Merton, and Scholarships at Exeter. I find that all students proceeding to scientific studies are required to pass responsions and moderations, both examinations requiring classics before they can do

so; and I believe this regulation is upheld by all the colleges. Cambridge, indeed, appears to be more liberal in this respect than Oxford, science men being simply required to pass responsions.

If by the "reserves" referred to by Professor Harcourt he means these examinations, I cannot see how he can go on to speak of the University system as being one of "free trade" in the same sentence. I shall be happy to own that Prof. Harcourt is right in his representations on production of evidence to the contrary of what I have stated: but so long as men are barred entering on the pursuit of science, as there is good reason to believe they are, by the intervening classical examinations, it is not to be wondered at that the study of science at the Universities gives a "result (which) is somewhat disappointing." We must not, however, lay this to the charge of a "free-trade" system, but rather to a system which favours classics at the expense of science, and thus practically gives the former an unfair monopoly.

I believe this question to be worthy of discussion in your journal, and hope that the Universities may soon see their way clear to make their system a "free trade" one as described by Prof. Harcourt.—I am, &c.,

W. H. WOOD.

Halifax, September 6, 1875.

MR. STEWART'S "NOTES UPON SUGAR ANALYSIS."

To the Editor of the Chemical News.

SIR,—In a recent number of the CHEMICAL NEWS (vol. xxxi. p. 212) there appeared a paper by Mr. G. C. Stewart, F.C.S., Greenock, entitled "Notes upon Sugar Analysis." As I am much interested in the literature of the subject, I have examined the various statements made by the author, and have been struck by the identity of many of them in idea as well as in expression to those made by well known writers on the same subject.

If Mr. Stewart would like me to point out these passages I will do so, but perhaps he will save me the trouble by making an explanation.

As the details of the methods of analysis given by Mr. Stewart are so apparently behind date, they are not likely to be followed by chemists engaged in the examination of sugar and molasses, and therefore I will not take up your space by offering remarks upon them in the meantime.—I am, &c.,

BEET.

September 6, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—I am perfectly in accord with Mr. Collins, except on one point; namely, as to the *limitation* of the title (as he puts it) for the proposed Mineralogical Society. I am by no means alone in thinking that if there is to be such a society it ought to be *cosmopolitan*. We have the Royal Society, the Geological Society, the Chemical Society, the Geographical Society, &c.; therefore, why not the Mineralogical Society? focussed, of course, where almost everything else of importance is, in London. British and Irish mineralogists have intelligent friends all over the world.—I am, &c.,

T. A. READWIN, M.R.I.A.

Liverpool, September 7, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—On reading Mr. J. H. Collins's and Mr. T. A. Readwin's letters referring to the formation of a Mineralogical Society of England, I was quite astonished to find that a society of such kind was not established till now. In Russia, in St. Petersburg; there is only one good mineralo-

gical museum of the Mining Institute, and the Russian Mineralogical Society, established more than fifty years, has quite enough work. In England, with its matchless collections of minerals and distinguished mineralogists, the absence of such a society may be considered as a sin.—I am, &c.,

SERGIUS KERN.

St. Petersburg, August 22, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Vol. lxxxi., No. 6, August 9, 1875.

Experiments on Gases under High Pressures.—M. Andrews.—The distinction commonly made between a gas and a vapour rests on a basis perfectly arbitrary, and without scientific value. The author proposes to call vapour every gas considered at a temperature whatsoever beneath the critical point—that is to say, the temperature at which one cannot, by pressure alone, reduce the gas to the liquid state. According to this definition, carbonic acid is a vapour below $+30^{\circ}$, a gas above that temperature. He has examined the properties of mixtures of nitrogen and carbonic acid under high pressures and at different temperatures. In these experiments he has gone as far as 284 atmospheres, and finds that under such circumstances the law of Dalton for gaseous mixtures does not apply. The critical point of the condensable gas in the mixture lowers, and that so much the more as the mixture contains more of an incondensable gas. Thus, in a mixture of 3 vols. of carbonic acid and 4 vols. of nitrogen, no liquid appeared at any pressure until the temperature had been reduced to -20° . In operating at temperatures above the critical point, the author has subjected carbonic acid to pressures increasing from 17 to 224 atmospheres. This gas shows great deviations from the law of Boyle or of Mariotte, and these deviations increase as the temperature lowers. The deviations from the law of Gay-Lussac presented by carbonic acid under high pressures have a great interest. The value of the coefficient of expansion (α) increases with the pressure in a manner truly remarkable. Thus, with a pressure of 40 atmospheres, and between 6° and 63.6° , $\alpha = 0.00945$, i.e., a little more than $2\frac{1}{2}$ times as much as under the pressure of 1 atmosphere. At constant pressures, the value of α changes with the temperature. In a word, the value of α , as coefficient of the elastic force, increases with the pressure and changes with the temperature.

On a Property of a Surface of Water Electrified.—M. G. Lippmann.—A mass of water unequally electrified contains at its surface an excess of oxygen proportional to the electric charge.

On the Sulpho-Carbonates.—M. Gélis.—The alkaline polysulphides do not yield, with sulphide of carbon, ordinary sulpho-carbonates of the formula CS_2, MS , but a new series of sulpho-carbonates, in which the monosulphide is replaced by an alkaline bisulphide, of which the formula is CS_2, MS_2 .

Preparation of Crystalline Monobromated Camphor.—M. Clin.—The author has obtained splendid specimens of this product by the direct action of bromine upon camphor at 100° , without pressure and without distillation.

Management of Marsh's Apparatus: its Application to the Determination of Arsenic contained in Organic Matter.—M. Arm. Gautier. The author succeeds in obtaining arsenical rings corresponding, to within 1 decimilligramme, with the weight of arsenic put into the apparatus.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 14, August 5, 1875.

M. Eug. Peligot has been nominated Administrator of the Assay Department of the French Mint.

M. Moigno gives a laudatory notice of the work of M. Decroix on the present consumption of horse-flesh, and on the advantages of hippophagy.

Electric Illumination.—The new iron works of M. Heilmann Ducommun are lighted up by means of electric currents, produced by the Gramme machine.

Phylloxera.—The treatment devised by M. Rohart has been experimentally tried at Montgaugé, near Chérac, and found successful. No light is thrown on the nature of the process.

Alloy of Copper Adhering to Glass.—Such an alloy may be obtained by mixing 20 to 30 parts of powdered copper (prepared by reducing the oxide with hydrogen or precipitating the sulphate with zinc) with sulphuric acid, and then with 7 parts of mercury. The whole is triturated and mixed with care. The acid is then removed by washing with hot water, and the mass is dried. After 10 to 12 hours it is hard enough to take a brilliant polish. If heated it softens, but does not contract on cooling. This alloy may be used to solder delicate articles which cannot bear a strong heat, and to stop teeth (!)

Production of Aniline Colours without the Use of Arsenic Acid.—The Tournai Company for the manufacture of aniline colours has commenced in its new works a process in which the use of arsenic is dispensed with. It appears to be Coupier's system, modified in some respects. The purity of the product leaves nothing to be desired, and it (probably magenta) is hence very suitable for the preparation of other derivatives. These colours may be used for articles of pharmacy and confectionery, liqueurs, syrups, &c.

Process for Detecting the Falsification of Fatty Oils.—M. Roth employs as reagent sulphuric acid at 46° B., saturated with nitrous gas by passing into it the fumes evolved by the action of nitric acid upon large pieces of iron. After 6 to 8 days the solution acquires a fine green colour indicative of perfect saturation. This reagent solidifies partially or totally the oleine of the non-drying oils. The purity may be judged by the time required for solidification.

Bulletin de la Societe Chimique de Paris,
August 5, 1875.

Products of the Dry Distillation of Caoutchouc.—M. G. Bouchardat.—The author, resuming the line of research initiated by M. Himly and Mr. Greville Williams, seeks to establish that all the products obtained by these two chemists, as well as caoutchouc itself, are the polymers of a carbide, $C_{10}H_8$, the isopren of Mr. Greville Williams.

Synthesis of a Terpien, or Camphenic Carbide.—M. G. Bouchardat.—Already noticed.

Chlorobromated Ethylen: Isomerism of its Chloride with the Bromide of Perchloric Ethylen.—M. E. Bourgoin.—Already noticed.

Action of the Chlorides of Alcoholic Radicals on the Primary and Secondary Monamines.—C. Girard.—The author has described, in a former paper, the action of nascent alcoholic chlorides upon diphenylamin. He has repeated the same reactions upon solid dicresylamin (α) melting at 77° to 78°. For this purpose he heated—in an enamelled autoclave, for 10 to 12 hours, at temperatures of 250° to 280°—a mixture of—

| | | |
|---------------------------------|-------|-----------|
| Solid (α) dicresylamin | .. .. | 100 grms. |
| Hydrochloric acid (1·17) | .. .. | 60 " |
| Methylic alcohol, pure | .. .. | 22 " |

The pressure attained about 20 atmospheres. It was let cool, decanted, treated with caustic soda, heated gently,

and then submitted to fractional distillation in vacuum. Dicresylamin α forming no further combination with acids, its separation from methyl dicresylamin cannot be effected by the action of a current of dry hydrochloric acid upon the benzol solution of the bases. Methyl dicresylamin is an oily mass; it does not form salts with acids. Aqueous solution of chromic acid and concentrated nitric acid merely produce a greenish yellow colouration. It is soluble in hot concentrated sulphuric acid, in alcohol, benzol, and ether. Ethyldicresylamin and amyldicresylamin have been prepared in the same manner, replacing the methylic alcohol respectively by ethylic or amylic alcohol. In their properties these tertiary monamines agree very closely. M. de Laire and the author have already pointed out that hydrochlorate of aniline is dissociated at 280° into aniline, diphenylamin, and hydrochloric acid. Taking this property as a point of departure, one of them had the idea of causing the alcoholic chlorides to react in the nascent state, in presence of water, upon the primary and secondary monamines. Thus, to obtain methyl-aniline it is sufficient to heat from 190° to 200°, under pressure, a mixture of—

| | | |
|--------------------------|-------|-----------|
| Pure aniline | .. .. | 100 parts |
| Hydrochloric acid (1·17) | .. .. | 120 " |
| Pure methylic alcohol | .. .. | 38 " |

If the proportion of methylic alcohol is doubled, very little is obtained save dimethylaniline, the substitution in this case not going further. The hydrochlorate of ammonia may be completely transformed into methylic bases by heating it for 10 to 12 hours to 260° to 270°, with an excess of methylic alcohol and a small quantity of hydrochloric acid. The reaction is so complete that it is suitable for the industrial preparation of the methylic bases.

Nature of the Astringent Principle of Mahogany.—MM. Latour and Paul Cazeneuve.—The astringency of mahogany is due to principles identical with those of catechu. Mahogany contains catechin and several congeneric or derived products of a less definite nature.

Two Isomeric Butylens obtained by the Action of Chloride of Zinc upon the Butyric Alcohol of Fermentation.—M. Nevole.—The one of these produced in larger quantities yields with bromine a bibromide boiling at 158° to 159°. The other, less in quantity, yields a bibromide boiling at 147° to 148°, and is probably identical with the pseudo-butylene of M. Boutlerow.

Determination of Sulphide of Carbon in the Alkaline Sulpho-Carbonates of Commerce.—MM. B. Delachanal and A. Mermet.—Already noticed.

Justus Liebig's Annalen der Chemie,
August 5, 1875.

On Dita Bark.—Jul. Jobst and O. Hesse.—Dita is the bark of *Echites scholaris*, a tree growing plentifully in the Philippines, and is used as a substitute for cinchona bark. Its efficacy seems due to a principle named ditain by its discoverer Gruppe, and present to the extent of 2 per cent. Doubts have arisen, however, as to whether this ditain is a true chemical individual, or a mixture of two or more possibly altered products. From the crude bark the authors have obtained:—1. Ditamin, a white, faintly bitter powder, too small in quantity to permit the determination of its composition. 2. Echicantchin, a tough, yellow mass, becoming brittle at temperatures below 0°. Its composition is—

| | | |
|----------|-------|-------|
| Carbon | .. .. | 80·64 |
| Hydrogen | .. .. | 10·75 |
| Oxygen | .. .. | 8·61 |

corresponding to the formula $C_{25}H_{40}O_2$. 3. Echicerin, a colourless substance forming acicular crystals. It contains—

| | | |
|----------|-------|-------|
| Carbon | .. .. | 81·81 |
| Hydrogen | .. .. | 10·91 |
| Oxygen | .. .. | 7·28 |

and may be represented by the formula $C_{30}H_{48}O_2$. Echiceric acid is an amorphous, inodorous body, easily soluble in alcohol, ether, and chloroform. Its formula is given as $C_{30}H_{46}O_4$. Further compounds obtained were echitin, $C_{32}H_{52}O_2$; echitein, $C_{42}H_{70}O_2$; echiretin, $C_{35}H_{56}O_2$; and a resinous body not examined. The authors do not consider dita bark a material likely to yield large quantities of well-defined alkaloid salts, and question its antifebrile value.

Communications from the Laboratory of Professor Lieben at Prague.—These communications consist of a paper on the synthesis of alcohols by means of chlorinated ether; account of solid benzoyl-chloride; and a notice of ethylenoxychloride.

On Pseudo-Propyl-Rhodanide and Allyl-Rhodanide.—Gustav Gerlich.—The former of these two bodies has the composition—

| | |
|------------------|-------|
| Carbon | 47.52 |
| Hydrogen | 6.93 |
| Sulphur | 31.68 |
| Nitrogen | 13.86 |
| | 99.99 |

corresponding to the formula C_4H_7SN . The latter contains—

| | |
|------------------|-------|
| Carbon | 48.48 |
| Hydrogen | 5.05 |
| Sulphur | 32.32 |
| Nitrogen | 14.14 |
| | 99.99 |

Represented by C_4H_5SN .

On Phlorein, Hæmatein, Brasilein.—Rudolf Benedikt.—The results of Weselsky's researches on the azo-compounds of resorcin (see these *Annalen*, 162, p. 273) and orcin (see *Berichte der Deutsch. Chem. Gesell.*, 7, p. 439) induced the author to try the same reaction in case of certain other compounds which might possibly have a constitution similar to that of these two derivatives of benzol and toluol. The behaviour of phloroglucin seemed interesting, since, judging from the decomposition-products of morin it stands in a close relation to resorcin. He has, in fact, succeeded in converting phloroglucin into a colouring matter, not, however, analogous with the diazo-compounds of Weselsky, but rather with two other well-known colouring matters, hæmatein and brasilein. Hence, he proposes to name it phlorein. It must be added that the author has discovered and determined nitrogen in both hæmatein and brasilein, and assigns to the former the formula $3(C_{16}H_{13}O_6)N$, and to the latter that of $3(C_{22}H_{17}O_7)N$.

Three New Pinacolins.—A. Wischnegradsky.—The three bodies in question are ethyl-butyl-pinacolin— $C(CH_3)_3COC_2H_5$; methyl-amyl-pinacolin— $C(C_2H_5)(CH_3)_2COCH_3$; and ethyl-amyl-pinacolin— $C(C_2H_5)(CH_3)_2-COC_2H_5$.

Derivatives of Acetylen.—A. Sabanejeff.—The author examines the action of bromine upon acetylen, and the resulting compounds: acetylen-tetra-bromide, solid tri-brom-ethylen, and acetylen-dibromide. He remarks that a main condition for the preparation of acetylen-dibromide by the reaction of bromine and acetylen, lies not so much in strongly cooling the bromine as applying it in dilute solution and keeping the acetylen in excess.

The action of iodine upon acetylen yields three compounds; a very volatile iodide not yet examined, a solid and a liquid.

The author is examining also the behaviour of acetylen with alcoholic potash, alcoholic ammonia, acetate of potash, acetate of silver, alcoholic potassium cyanide, and mercury cyanide, sulphite of ammonia, sulphides of potassium and ammonium, and of aniline.

MISCELLANEOUS.

Anderson's College, Glasgow.—Mr. E. J. Mills, D.Sc., F.R.S., has been appointed Young Professor of Technical Chemistry in this College, Prof. Gustav Bischof having resigned.

United States Board, appointed to Test Iron, Steel, and other Metals.—The Committee on Corrosion of Metals of the United States Board, appointed to test Iron, Steel, and other Metals, asks the assistance of all whose tastes, interests, or occupations have induced them to note the rate and mode of destruction (by corrosion) of the metals used in construction. Full and clear statements are required of all cases observed which show a remarkably rapid rate of corrosion or the reverse. It is very desirable, whenever practicable in these cases, to get a sample of the metal and of the scale or crust formed, for the purpose of chemical analysis. These samples may be forwarded to Col. T. T. S. Laidley, President of the Board, at Watertown Arsenal, Watertown, Mass., accompanied by a full statement of all the known conditions which have influenced the rate of corrosion in the particular case observed. The samples so forwarded will be carefully analysed. Important as the subject of the corrosion of metals is, the information touching it is so meagre and indefinite that the rate of destruction cannot be predicted with certainty in any given case. The Committee ask to be referred to such sources of information as may be deemed valuable—such as reports of engineers, architects, and scientists, or articles touching this subject contained in scientific publications. The Committee consists of—Wm. Sooy Smith, C.E., Chairman, Maywood, Illinois; Lieut.-Col. Q. A. Gillmore, U.S.A., Army Building, New York City; Com. L. A. Beardslee, U.S.N., Washington, D.C.

NOTES AND QUERIES.

Chrome-Iron Alloy.—Can any of your readers give me more information on the matter than is contained in the article on page 136 of your present volume. From whom can the ore be obtained?—G. G. B.

TO CORRESPONDENTS.

. We cordially thank those gentlemen who kindly sent us information respecting the Chemical and Medical Schools for our Students' Number.

G. Valentine.—Consult "Select Methods in Chemical Analysis," published by Longmans and Co.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 826.

THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION.*

II.

THE facts elicited by the Commission prove that in their opinion, and most assuredly in ours, "Science is as yet very far from receiving the attention to which it is entitled" in our public and endowed schools. "Even where science is taught, from one to two hours' work per week may be regarded, with very few exceptions, as the usual time given to it in such classes as receive scientific instruction at all. Among the 128 endowed schools from which we have received returns, science is taught in only 63, and of these only 13 have a laboratory, and only 18 apparatus, often very scanty. Out of the 128 schools 30 allot no regular time whatever to scientific study; 7 only one hour a week; 16 only two hours; whilst out of the whole number only 18 devote as much as four hours to it. The neglect with which it is treated is also clearly shown by that portion of the Assistant Commissioner's Report in which the weight attached to science in the school examinations is stated, whence it appears that among the higher grade schools from which information has been received, *only two* attach a weight to science in the examinations equal to that of classics or mathematics, while in the case of the 128 endowed schools from which information has been received only 13 give any weight at all to science in the examinations."

Hence it would appear that England, in 1875, is about on a level with Germany in the year 1820, before the great impulse given to scientific education by Liebig and his contemporaries. We are half a century in the rear, and are not yet even agreed as to the best means of recovering this amount of lost ground!

If we examine the causes of this alarming and dangerous neglect, we come first upon the vulgar notion that science, if needful, may be "picked up" at any time, and need not, therefore, be introduced into the educational course of our schools and colleges. Now that a smattering of science may thus be picked up at hap-hazard we do not deny. But no amount of mere reading will give a man a sound acquaintance with any science—much less qualify him to enter upon original research. For these purposes actual work under an experienced instructor is absolutely necessary.

Another prevailing delusion is, that whilst classics and mathematics have a high and peculiar value as means of mental discipline, independently of any special application they may admit of in the pursuits of the student, science has no such value.

Against this view we hold that it is difficult to protest too emphatically. The main business of life, as far, at least, as the conduct of the intellect is concerned, may be said to consist in drawing correct conclusions from facts carefully observed. For this double purpose, we hold that the different branches of science, physics, chemistry, or biology, furnish an

admirable training. The classicist fixes his attention upon words rather than upon things. He does not learn to discriminate between minute gradations of colour, texture, or form. The mathematician may reason admirably, but from the same neglect of the powers of observation he is exceedingly apt to build his arguments upon an unsound basis. For a perfect education, language, mathematics, and physical science are all necessary. But the last-mentioned is certainly not less important than the two former; nor, if one of the three must be omitted, is it the one which we should doom. Better a man should be able to tell us new and important truths, even in clumsy and inelegant language, than that he should repeat errors and absurdities in the most faultless periods.

The Commissioners, in our humble opinion, scarcely go far enough in their recommendations. They do, indeed, "insist on the introduction of scientific training as an integral part of school education." They propose that in all public and endowed schools a substantial portion of the time allotted to study should, throughout the school course, be devoted to natural science; and are of opinion that not less than six hours a week on the average should be appropriated for this purpose, and that in all general school examinations not less than one-sixth of the marks be allotted to natural science."

"Half a loaf," says the old proverb, "is better than no bread," and we must, therefore, look upon this proposal with due thankfulness. But we think that natural science might well claim, not one-sixth, but one-third, of the examination marks. So long as it can command merely one-sixth, students whose tastes and mental peculiarities incline them to the special study of any department of physical science will find themselves heavily handicapped in comparison with those of their comrades of a more literary turn.

The Commissioners further recommend that "students at the Universities should at an early period, if not from the commencement of their academical course, be left free to choose for themselves among the principal lines of study, and should not be hampered by being compelled to pass examinations in subjects having no direct bearing upon their subsequent career."

This sounds refreshing, but it is hampered by one of those saving clauses which so often mar the effect of laws and recommendations:—"But we make this recommendation conditionally; that is, upon the understanding that the student should be well grounded in the principal branches of knowledge before his entrance into the University, asserting that literary cultivation up to a certain point is indispensable for the scientific student."

Up to what point? Is it not perfectly conceivable that a man might display the highest merit in chemistry, physics, or biology, and yet be totally ignorant of Greek and Latin? Would not the fairest method be to grant degrees—or, if deserved, honours—in any one branch of knowledge which he might select, totally irrespective of his proficiency or non-proficiency in other spheres?

We have not the least intention of undervaluing literature in general, or classical study in particular. But we cannot help regarding it as a neighbour from whose encroachments science has hitherto suffered, and which it is very important to confine for the future within reasonable bounds,

*"Sixth, Seventh, and Eighth Reports of the Royal Commission on Scientific Instruction and the Advancement of Science." London: Printed for Her Majesty's Stationery Office, 1875.

THE AUGMENTATION OF THE CHEMICAL ACTIVITY OF ALUMINIUM BY CONTACT WITH A MORE NEGATIVE METAL.*

By Dr. J. H. GLADSTONE, F.R.S., and ALFRED TRIBE.

HAVING had occasion to employ aluminium for effecting certain decompositions, we were induced to determine whether covering its surface with more negative metals would so augment its chemical affinity as to enable it to decompose water below or at 100° C.

According to Deville, the metal *alone* only decomposes water at a white heat.

The following experiments were made:—

(a). 0.43 grm. of metallic copper was deposited upon 6 grms. of aluminium foil (126 c.m. long, and 5 c.m. wide), in a 2 oz. flask, by immersion in very dilute copper sulphate, very slightly acidulated with hydrochloric acid. The couple so obtained was completely freed from sulphate and chloride by washing with pure water.

(b). 0.2214 grm. of platinum was deposited upon a similar quantity of foil by immersion in dilute platinic chloride, and was washed as in the former instance.

The results obtained were as under:—

| Temperature. | Time. | AlCu Experiment. | AlPt Experiment. |
|--------------|----------|------------------|------------------|
| 12° C. | 22 hours | 2.5 c.c. | 4 c.c. |
| 100 | next 6 „ | 375.0 „ | 484 „ |
| 100 | „ 6 „ | 92.0 „ | 114 „ |
| 100 | „ 6 „ | 55.0 „ | 78 „ |
| 100 | „ 6 „ | 33.0 „ | 45 „ |

The flasks containing these preparations were filled with water, and after standing twenty-two hours at ordinary temperature, were heated to 100° C. The fact brought out by the above experiments was further established by other decompositions, and is, of course, corroborative of our work with zinc conjoined to more negative metals in a spongy condition.

NOTES ON THE ACTION OF THE COPPER-ZINC COUPLE.*

By Dr. GLADSTONE, F.R.S. and ALFRED TRIBE.

Relative Activity of Pure Zinc, and Zinc Covered with Spongy Copper.

A SOLUTION of sulphuric acid containing 3½ parts of acid to 1000 of water, is just acted upon by pure zinc.

In an experiment with 2.5 grms. pure granulated zinc immersed in acid of this strength, seven volumes of hydrogen were evolved in one hour.

In another experiment in which the same piece of zinc upon which 0.003 grm. of copper had been deposited, was used, eighty volumes of gas were given off in the same time.

Thus it appears that the activity of zinc in very dilute sulphuric acid is increased eleven fold by less than 0.12 per cent of the negative metal.

Arseniuretted Hydrogen.

If zinc containing arsenic be acted upon with dilute sulphuric acid, the hydrogen evolved will, as is well-known, contain AsH₃; the formation of which is explicable (from analogy with what is known of the action of hydrogen upon oxy-nitrogen compounds) on the supposition that the arsenic becomes dissolved, and that by the subsequent action of hydrogen upon the arsenical compound in solution, the arseniuretted hydrogen is produced.

Some four years ago we pointed out that the copper-zinc couple in presence of water effects the decomposition of that fluid, zinc hydrate and hydrogen being produced.

According to Bousdorff, arsenic does not dissolve in

water free from dissolved oxygen—a fact which we have verified—and also that dilute sulphuric acid does dissolve it.

Now if the foregoing view of the formation of the AsH₃ be correct, the hydrogen obtained by the action of the couple upon water should be free from arsenical gas, even though the couple be made with arsenical zinc.

We give the results of four experiments. A quantity of arsenical zinc foil was “coupled” with copper washed and heated with water, and the two litres of gas evolved passed through a tube heated to redness. Not a trace of arsenic was noticeable.

Another portion of the same foil was treated with dilute sulphuric acid, and two litres of hydrogen given off passed through a tube heated as before. 0.0019 grm. of arsenic was deposited in the cool part of the tube.

The same zinc “coupled,” when treated with dilute sulphuric acid, gave arseniuretted hydrogen, which appears to point to the conclusion that it is not the presence of the copper, but the inability of the arsenic to get into solution that accounts for the absence of arsenic in the gas obtained from water and the couple, a conclusion confirmed by adding a dilute solution of arsenic (1 part of As₂O₃ in 12,000 water) to same couple, when immediately the arsenical mirror was produced in the heated tube.

PRODUCTION OF SULPHURIC ACID.

MR. HERMANN SPRENGEL's application of atomised liquids in operations where a liquid is made to act as an absorbent of a gas possesses great advantages. The method has been applied with success to the purification of coal-gas, and to the condensation of hydrochloric acid, and by its use great improvements in the production of sulphuric acid have been effected. It is well known that sulphuric acid as contained in the chambers contains about 50 per cent of water and that all this water was once steam, and was taken as such from the steam-boiler. Before being condensed in the chambers this steam occupied a certain space, and moreover helped (on account of its heat) to expand the bulk of the other gases used in the formation of sulphuric acid. In winter time the yield of acid is better, and the consumption of nitre less, than in summer time; and the greater the chamber-space (*i.e.* the smaller the volume of gas allowed to pass the chambers in a certain time) the less will be the consumption of nitre (in proportion to the acid produced) and the easier will be the conversion of all sulphurous into sulphuric acid.

Hence, as the *lowering* of the temperature of a gas necessarily implied the *shrinking* of its volume, both of which favour the process of sulphuric-acid-making, Mr. Sprengel commenced to manufacture sulphuric acid by means of what has been called “*pulverised or atomised water or spray*,” which he injects into the chambers as a substitute for steam. This effects (1) a saving of fuel equal to the amount which is required to convert this pulverised water into steam, and (2) a cooling of the chambers equal to the loss of the amount of heat which would have been generated by the combustion of the coal thus saved.

The spray is produced at present by means of “some” steam, which is made to escape from a platinum-jet under a pressure of about 2 atmospheres into the centre of a flow of water, as shown in the figure.

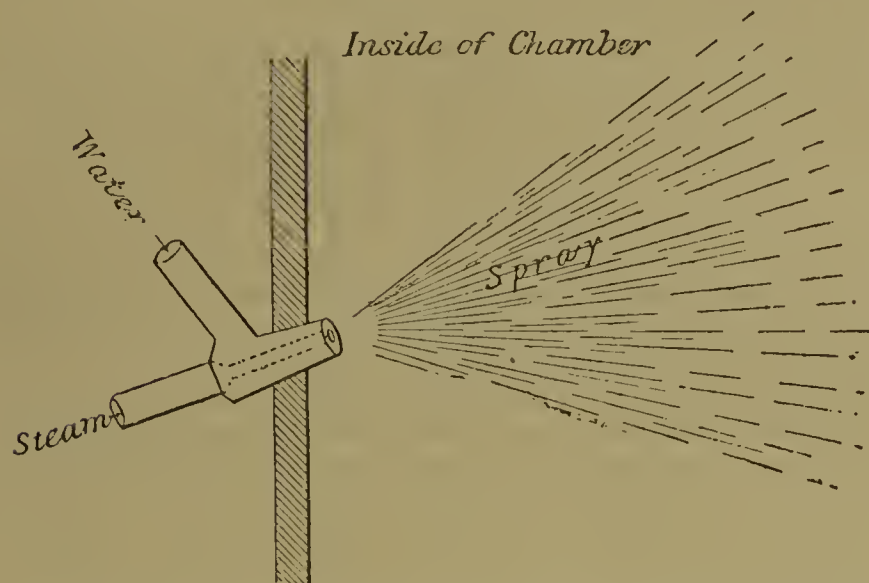
20 lbs. of steam will thus convert 80 lbs. of water into a cloud-like mist, the actual weight of which, issuing from a jet of the above size, amounts to about ½ ton in twenty-four hours. These jets are placed in the sides of the chambers about 40 feet apart. They are supplied with water from a tank above, while the steam is taken from the steam-pipes already existing between the chambers, or better from smaller ones put in their place.

At the works of the Lawes Chemical Manure Company the saving in coal amounts about two-thirds of the quantity

* Read before the British Association, Bristol Meeting, Section B.

formerly burned. It is generally believed that a moderate temperature favours the formation of sulphuric acid, but Mr. Sprengel has found that the stronger the frost the better was the condition and the yield of the chambers.

The "spray-acid" has been produced with $6\frac{1}{2}$ per cent less pyrites and with $14\frac{3}{4}$ per cent less nitre than the "steam-acid," which was made from the same material during the two years preceding the application of the spray. These numbers, moreover, refer to the yield of chambers without Gay-Lussac and Glover towers.



In factories where these towers are in use the saving will be probably one-third less, at least as far as steam is concerned. But as it is believed that a considerable proportion of nitrous acid becomes destroyed in the Glover tower by the heat of the gases from the kilns (*i.e.*, broken up into oxygen and nitrogen), Mr. Sprengel thinks that for the sake of coolness this acid is better distributed in the interior of the chambers as spray. The Glover tower of course will still serve as an admirable instrument for concentrating chamber acid.

At the works of the Lawes Chemical Manure Company the construction of the apparatus came to about £10 per chamber, while the savings in steam, acid, nitre, and labour during three months amounted to 5s. per ton of acid of 1.6 sp. gr., made from pyrites.

No doubt different localities, different care, and different prices will lead to different results. But even if the savings should elsewhere be considerably less, the result will still appear acceptable, considering the simple and inexpensive means by which it has been attained and the large consumption of the article which it helps to cheapen, for 1s. per ton saved or wasted means, with reference to England's annual consumption, about £50,000.

THE POSITION AND CHARACTER OF MERCURY AND COPPER, FOUNDED UPON THEIR ATOMIC WEIGHTS.

By C. T. BLANSHARD, F.C.S.

AFTER reading the valuable article by Mr. Newlands in the CHEM. NEWS, vol. xxxii., p. 21, which I have only lately had the opportunity of seeing, there seem to be some anomalies in the hypothesis of chemical properties being dependent on atomic weight, atomic volume, &c., that require explanation.

Mercury and copper are two well-known metals, which behave equally as monads and dyads, with essentially different properties according to their atomicity in the compound.

Mendelejeff, one of the first to work at this subject, gave in vol. 2 of his "Modern Chemistry" (Petersburg, 1873), a table of the elements classified according to their atomic weights, it being in fact the very table whose absence from our text-books Mr. Newlands laments. In this table 100 is put down from calculation as one

of the missing numbers. Again, this number might, as Newlands shows, represent a monatomic element. This missing element I take to be mercury acting as a monad. For when diatomic mercury has the atomic weight 200, or more accurately perhaps 199.8, as given by Mendelejeff, the monad would be represented by 100.

I hope to show that mercury with this atomic weight has a legitimate place amongst the elements, as distinct from the metal whose atomic weight is 200.

(1.) Mercuric chloride is soluble in water, Hg'' belonging to the natural group, zinc, cadmium, and mercury, the representatives of which are more volatile as the atomic weight increases (their specific heats and other physical properties also show that they form a natural group); whilst mercurous chloride is insoluble in water, being analogous to silver chloride.

(2.) Mercury = 100, and silver = 108, each heads a group of elements arranged according to increasing atomic weight and valency (*vide* CHEM. NEWS, vol. xxxii., p. 21.)

(3.) The number 100 being not very different from 108, similar properties may be expected in the elements, as is frequently the case, *e.g.* nickel, cobalt, and iron; cerium and lanthanum, &c.

(4.) On referring to *Annalen der Chem. u. Pharm.*, Supp. vii., p. 380, it will be seen from Meyer's table of curves, the ordinates giving the atomic volumes, the abscissæ the atomic weights, that with the atomic volume 7.35 (Hg' = 100) mercury, the monad, occupies a position at the lower apex of a curve, where according to Meyer's laws for the curves it should have the properties of being easily liquefiable and heavy, as mercury undoubtedly has. Again, it occupies here a similar position to monatomic copper in the curve preceding.

So, then, the properties of mercury as a monad, its atomic weight, and its atomic volume, whether derived from theory or experiment, agree together to show that this element should have the position here assigned to it in Meyer's curve; and further, the chemical properties of the monatomic metal are explained by reference to its atomic weight, equally well with other known elements, diatomic mercury included.

As regards copper, both Mendelejeff and Newlands regard this metal as being normally a monad. This view is entitled by the atomic weight, just less than that of the diad zinc, and by the existence of such compounds as the hydride (CuH), and the vinyl compounds (C₂HCu₂)O and (C₂HCu₂)(OH), strictly analogous to the silver compounds (quoted from Berthelot in *Journ. Chem. Soc.* for last month). The relation of copper to silver and monatomic mercury being explained by reference to the atomic weight, the diad nature of copper remains to be accounted for on this hypothesis.

If it be correct to take the atomic weight of diatomic copper as double that of Cu', *i.e.* 126.6, then the position of copper both in Meyer's curve and in the scale of classification by atomic weights, becomes apparent. Cu' = 126.6 has the atomic volume 14.4. It will then occupy the position of a metal in the curve between the triad antimony and the monad iodine; copper being on the falling part of the curve as a metal, and a difficultly fusible body, whilst tellurium, with nearly the same atomic weight, has a normal position on the rising curve as an electronegative body. Meyer marks the position of tellurium as abnormal, but giving it an atomic weight of about 126, it will just precede iodine, as selenium just precedes bromine on the adjoining curve.

If this be the true view, then there are two diads (or exhads) coming between antimony and iodine. This is not unparalleled, as nickel and cobalt, two metals of the same atomicity and the same atomic weight (as far as experiment has yet shown) occupy one position in the group with iron. Mr. Newlands has represented cobalt as a monad or heptad in his table, but this is perhaps an erratum, as the analysis of cobalt compounds would hardly admit of such a view.

I trust that these remarks will help to confirm the truth of the hypothesis put forth by Newlands and others, by accounting for some apparent anomalies; and that they will show that the properties of the so-called elements are related to the numbers themselves that represent their atomic weights and atomic volumes, rather than that the elements admit of any mere linear classification.

Leamington, September 16, 1875.

ON THE ACTION OF PHOSPHORUS PENTACHLORIDE ON ACETAMIDE.

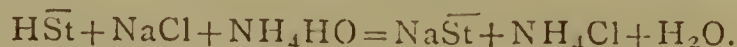
By RALPH W. EMERSON MAC IVOR, F.C.S.,
Andersonian University, Glasgow.

THE *Journal of the Chemical Society* for the present month contains an abstract of a paper on the "Action of Phosphorus Pentachloride on the Acid Amides," by O. Wallach, published in *Deut. Chem. Ges. Ber.*, viii., 299-309, in which that chemist denies the statement, made by Henke, to the effect that PCl_5 acts violently on acetamide. Wallach states that the two compounds scarcely act on each other in the cold, only a small quantity of acetamide hydrochloride being formed; if the reaction takes place in chloroform, it becomes violent, but the product is the same, and when the amide and pentachloride are heated together for some time, they yield acetonitril, together with phosphorus trichloride and oxychloride. Some time ago I made a few experiments on the subject, and obtained results which fully confirm those arrived at by Wallach.

SOAP DIRECT FROM COMMON SALT.

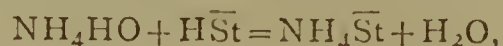
By T. N. WHITELAW.

WHEN any fatty or resinous body commonly used in soap-making is heated with excess of common salt, ammonia, and water, soda-soap forms and separates, while the solution contains the excess of ammonia and common salt, together with ammonium chloride. Thus, with stearic acid:—

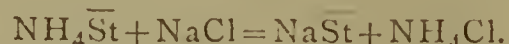


This reaction depends on the ready solubility of ammonia-soap in water containing ammonia, and the insolubility of soda-soap in water containing more than 0.5 per cent of sodium chloride.

The ammonium first combines with the fatty acid—



but immediately exchanges with the sodium of the common salt—



As explained above, an excess of ammonia and salt is requisite; 100 parts of fatty matter require from 15 to 20 parts of NH_3 , 20 to 30 parts of salt, and 200 to 300 of water.

The Germans make soap on a similar principle, potash-soap being first formed, then decomposed with common salt; but by this process the resulting soap contains soda and potash in nearly equal quantities, the decomposition being incomplete.

With ammonia, however, the reaction is nearly complete, about 9-10ths of the base being soda; and one can easily remove the remaining 1-10th of ammonia by washing with water containing common salt; there then remains a soap with part of the acid unsaturated.

Resin-soap, formed in this way, contains almost the full quantity of soda, but the completeness of the reaction depends greatly on the amounts of ammonia and salt

relative to the fatty matter, a slight variation in these altering considerably the product.

When one uses free fatty acids or resin, the formation of soap occurs at once, on simply heating in a closed vessel slightly above the melting-point of the fatty acid or resin and agitating. But, with neutral fats, the case is different; it is then preferable to heat the ammonia solution and fat to 150°C . in a closed vessel, when ammonia-soap and glycerine form; the ammonia-soap can then be decomposed with sodium chloride as before described.

The action of ammonium chloride on common soap is peculiar, and such as would lead one to expect that the above formation of soap with the aid of ammonia could not occur. It does not separate soda-soap from solution, after the manner of common salt (as is usually stated in works on soap-making), but, on heating, evolution of ammonia takes place, and when sufficient salt forms, by the combination of the sodium of the soap with the chlorine of NH_4Cl , an acid-soap separates; on prolonged boiling, the soap is completely decomposed, common salt remaining in solution and fatty acids floating on the surface.

The process might, practically, be of some value; it has the same difficulty to contend with as that for the conversion of common salt into sodium carbonate with the aid of ammonia, and that difficulty, the chance of losing ammonia would probably be much less. Allowing 5 per cent loss of NH_3 in each complete operation, the alkali in soap would still be considerably cheaper than by the present methods.

Again, the salt at present lost in the operations of soap-making, with the labour and fuel of alkali-making, would in great part be saved.

Sidney Street, Glasgow,
Sept. 6, 1875.

ON THE RADICAL AMMONIUM.

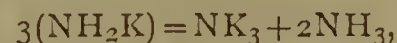
By SERGIUS KERN, St. Petersburg.

THE radical ammonium (NH_4), according to Weil (*Pogg. Ann.*, cxxiii., p. 350), may be obtained by the action of ammonia gas in sealed tubes on a mixture of metallic potassium with a salt of ammonium (NH_3HCl); a dark blue liquid is obtained, existing only at a high pressure and yielding easily at a higher temperature free ammonia and hydrogen. Some chemists explain the formation of ammonium in this way by the following process: the ammonia first combines with the ammonium chloride, and on this compound the metallic potassium then acts, yielding free ammonium. But the existence of a compound of NH_3 with NH_3HCl cannot be adopted, as proved by experiment.

In further experiments it was remarked that the liquid contained a considerable quantity of amido-potassium (NH_2K), and the blue colour of the liquor is thus very easily explained, as the NH_2K represents in a fluid state a blue coloured liquid. The reaction which takes place is the following; it explains also the presence of free hydrogen in the tube:



The presence of ammonia in free state, and the change of colour of the product in the tube into a solid brownish-green mass may be ascribed to the decomposition of amido-potassium, which, as it is known, decomposes by the following equation:—



These experiments I suppose prove that the production of free ammonium by this process is doubtful, and that the formation of ammonium is till now an open question. Numerous experiments were made with ammonium-amalgams, but by these means the studying of the properties of ammonium is impossible, owing to the instability of the compounds obtained. By acting on a mixture of cuprous sulphate (Cu_2SO_4) and ammonium chloride by

means of a powerful battery an alloy of copper and ammonium was obtained on the negative pole, containing not more than 1 per cent. of ammonium in the form of a greyish-red spongy mass. The experiments made with this alloy were very unfortunate, and the attempts to isolate the ammonium showed only the probability of obtaining ammonium in a form of a solid mass resembling the metals of alkalis.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.
(Continued from p. 133.)

IN 1842, Zinin succeeded in converting nitrobenzol into aniline by the action of nascent hydrogen, and thus opened out an industrial region of unimagined extent. The era of the artificial dyes followed. It was soon perceived that many of these substances shared with indigotin the property of being decolourised by hydrogen, and thus zinc-powder was introduced into calico-printing as a discharging agent, which, developing hydrogen in patterns where it is printed on, removes artificial colouring matters, e.g., magenta.†

A series of interesting observations showed, however, that the manner in which hydrogen is evolved is not without influence on hydrogenisation. Whilst ammonium sulphide, and whilst acids under the influence of metals give up so much hydrogen to nitrobenzol as to form aniline, if other sources of hydrogen are employed the reaction is arrested half-way and intermediate products are generated. Herewith, therefore, nascent hydrogen escapes from our general consideration, and its technical application will be described in future parts of this report.

We return, therefore, to its applications as a source of heat and light. It has been briefly described in the section on oxygen how the oxyhydrogen blast was evolved from the experiments of Saron between 1780 to 1790, and how it was introduced in the manufacture of platinum in the middle of the present century by Deville and Debray. Since 1838‡ Desbassains de Richemont found in hydrogen mixed with air the means for the autogenous soldering of sheets of lead, and thus supplied the sulphuric acid manufacture with the fundamental condition of its growth, i.e., permanent lead chambers of any desired magnitude. If, in places where coal-gas is readily procurable, this combustible is substituted for hydrogen in soldering lead, many sulphuric acid chambers are not near gas-works, and in them hydrogen is still necessary for soldering. The same must be said on the application of hydrogen for the autogenous soldering of other metals and alloys, a process for which Winckler, in his convincing essay already quoted, predicts a great future. More recently, lead pans soldered in this manner have been introduced in the manufacture of boracic acid in Italy. Numerous conflagrations, especially that of Canterbury Cathedral in 1871, and that of the Alexandra Palace on Muswell Hill in 1873, demonstrably due to the braziers full of fire used in soldering the leaden spouts, have led, in England, to the proposal to solder leaden roofing and spouting with hydrogen.

How far hydrogen is superior to other kinds of fuel appears from the following table. According to the experiments of Favre and Silbermann, 1 grm. of the following bodies, when burnt in water, gave the appended number

of calories, i.e., it raised, by 1°, the temperature of the given number of centigrammes of water.*

| | |
|--|--------|
| Hydrogen | 34'462 |
| Carbonic oxide | 2'403 |
| Oil of turpentine | 10'852 |
| Stearic acid | 9'716 |
| Alcohol | 7'814 |
| Marsh-gas | 13'063 |
| Wood charcoal (burnt to carbonic acid) | 8'080 |
| Ethylen | 11'858 |
| Ether | 9'028 |

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

THE following communication from the Secretary of the General Post-Office will be of interest to Public Analysts:—

General Post-Office, September 16, 1875.

SIR,—With reference to your letter of the 13th instant, I beg leave to forward you, in compliance with your request, the enclosed copy of the regulations relating to the conveyance and delivery by post of packets addressed to Public Analysts under the provisions of "The Sale of Food and Drugs Act.—I am, Sir, your obedient servant,

JOHN TILLEY, Secretary.

G. W. Wigner, Esq.,
Hon. Sec. Society of Public Analysts,
79, Great Tower Street, E.C.

Instructions in Connection with "Sale of Food and Drugs Act."

Under the provisions of the 16th Clause of the "Sale of Food and Drugs Act," 38 and 39 Vict., c. 63, which is appointed to come into operation on the 1st of October next, the following regulations have been laid down by the Postmaster-General, in regard to the conveyance and delivery of such articles as are permitted by the Act to be forwarded to duly-appointed Analysts as registered letters through the post:—

1. Each packet must be addressed according to the Official designation of the Analyst, as "Public Analyst" or otherwise, and the nature of its contents must be stated on the front of the packet.
2. Any Postmaster, at whose Office a packet for a Public Analyst shall be tendered for registration, may refuse to accept it for this purpose, unless it be packed in so secure a manner as to render it at least unlikely that its contents will escape and injure the correspondence.
3. Liquids for analysis shall be contained in stout bottles or bladders, which shall be enclosed in strong wooden boxes with rounded edges—the boxes being covered by stout wrappers of paper or cloth; and no such packet shall exceed 8 inches in length, 4 inches in width, or 3 inches in depth.
4. No packet whatever addressed to a Public Analyst shall exceed the dimensions of 18 inches in length, 9 inches in width, or 6 inches in depth.

The postage and registration fee on each packet must, of course, be prepaid.

By command of the Postmaster-General.

General Post-Office, 6th September, 1875.

THE COST OF PUBLIC ANALYSTS IN IRELAND.

DR. CAMERON, Public Analyst for the county of Kildare, reported to the Grand Jury at the last meeting that he had made 63 analyses of food during the year, of which 17 had been adulterated: 14 adulterators were convicted,

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† The transformation of the coloured salts of rosanilin into the colourless salts of leucanilin by means of zinc and hydrochloric acid was discovered by A. W. Hofmann in 1860.—*Proc. Roy. Soc.*, vol. xii., p. 2. The above application is due to Durand. See Schützenberger, "Traité des Matières Colorantes," vol. i., p. 491.

‡ Karmarsch, "Geschichte der Technologie," 380.

* A. Würtz, "Dictionnaire de Chimie," vol. i., pp. 825, 82

and the fines, exclusive of costs, amounted to £45, which sum had been paid over to the county treasurer. As the Analyst's salary is £30 a year, the county made £15 nett on his operations. Kildare is a small, purely rural, county, containing no town of more than 4000 inhabitants.

NOTICES OF BOOKS.

Fifth Annual Report of the Deputy Master of the Mint, 1874.

FROM this report we learn that experiments in connection with spectroscopic assaying have been continued during the past year. Of these one of the most interesting has been "the verification of the degree of purity of the fine gold trial plate, by comparing it with the solar spectrum." It was already known that the plate did not contain any impurities which could be detected by ordinary analytical methods, and it appears that the gold withstood the more delicate test of the spectroscope, no impurity being found present. A map of the gold spectrum as compared with the solar spectrum is now in course of preparation.

The total number of assays executed has been 2521 of gold and 7917 of silver. No gold was set aside during the year on account of brittleness.

In the special report of Mr. Chandler Roberts, the able Chemist to the Mint, reference is made to the volumetric method of assaying silver by means of hydrobromic acid, as described by M. Stas and to Volhard's new volumetric assay. This latter method is based on the fact that silver is entirely precipitated from solution by soluble sulphocyanides. An acid solution of nitrate of silver is used containing a little sulphate of iron, and the completion of the process is indicated by the appearance of a blood-red colour. This method is pronounced "rapid," accurate, and well adapted for the assay of alloys containing more than 70 per cent of silver."

Monthly Report of the Department of Agriculture, for February and March, 1875. Washington: Government Printing Office.

IN this interesting report we notice a strange, and in our opinion a very unnecessary, discussion as to the comparative value of farm-yard manure and of chemical manures. Of course no farmer in his senses will allow the excrements of his stock, or any other refuse, animal or vegetable, produced on the farm to be wasted. But however carefully such manures are collected and returned to the soil, we must recollect that a large proportion of the farm produce—*e.g.*, grain, milk, cheese, &c.,—is not consumed on the spot, but sold away. Now unless all the excreta of the persons, &c., eating such produce (or those of a similar number) could be likewise brought back to the farm, the soil must ultimately deteriorate, without the aid of chemical manures. Careful cultivation, drainage, subsoiling, &c., will, of course, delay the appearance of sterility, and may, for a certain time, even cause the soil to improve. But unless we are prepared to admit that vegetables and animals can create within themselves matter which they do not derive from their food, we cannot consider that "home-made manures" can permanently maintain the fertility of a plot of land under regular cropping. Of course if a farm is dressed with rotted leaves from a neighbouring forest, or with the ashes of wood brought from a distance, the deterioration of the soil may be delayed or prevented. But this is only robbing one plot of land for the benefit of another,—an evil which in fact underlies the use of bone manures, animal charcoal, blood manure, and the like.

We learn with surprise that in the mild climate of Florida "it is esteemed lucky if cattle and sheep survive the winter."

It is reported that in 1874 3,100,000 lbs. of buffalo-bones were forwarded on the Kansas and Pacific Railway.

Sixth Annual Report of the State Board of Health of Massachusetts. January, 1875. Boston: Wright and Potter.

WE have here another valuable collection of results bearing upon sanitary science. We quote the following noteworthy passages:—

"The most recent experiments tend to show that we have been vastly overrating the oxidising and disinfecting properties of air, water, and earth.

"As to the final disposal of sewage, it is not yet possible to say definitely which one of the many plans now suggested and tried in different parts of the world will become generally adopted as possessing the least number of disadvantages, and the question must often be decided with reference to purely local considerations."

The slaughtering of cattle and swine appears to be the source of much nuisance in Boston, where 750,000 of the latter animals are annually killed within two miles of the State house. On this subject the report contains the following remarks, which will be found applicable to many nuisances of other kinds:—"The odours, generally speaking, were shown to be distinguishable, if taken singly, although their combination in many cases rendered it impossible to trace the offence of a given time to its proper source. They were shown, too, to be diffused to some degree in all directions, whatever the barometric pressure of the atmosphere, or the direction of the prevalent wind if not blowing violently. When the winds were light and variable, forming currents and counter currents of air, the noxious odours were as capricious as the winds themselves, and by the use of high chimneys they were sometimes offensive at a distance when scarcely perceptible at their source. They also existed at times in sharply defined strata, so as to be nauseating at one part of a house and not disagreeable in another." The so-called "soup," or liquor from rendering establishments, still escapes into the waters of Boston to the extent of many tons daily.

Dr. Adams, of Pittsfield, has contributed a paper on the "Comparative Advantages of Burial and Cremation." He holds "that there exists no necessity, on sanitary or economic grounds, for any change at present in our manner of disposing of the dead."

The bibliography of the subject is given at great length, and will prove very useful to all desirous of studying this question. The papers on the "Ventilation of Railway Carriages," and on the "Meat Supply in Reference to Public Health," are also very valuable.

Chemical Examination of Alcoholic Liquors. By ALBERT B. PRESCOTT, M.D. New York: D. Van Nostrand.

The author gives, in a terse, compact form, a great amount of information on alcoholic beverages, their normal constituents, their impurities, and the intentional sophistications to which they are liable. Thus under whisky we read that "it is sometimes directed to add one or two drops each of creosote and purified fusel oil to the gallon!" "There is no evidence that strychnia has ever been used in the making up of whisky or other distilled liquor."

"Absinthe," we are told, "is a liqueur with 40 to 60 per cent by volume of alcohol and several per cent of volatile oils—those of wormwood, cinnamon, cloves, anise, and angelica being chiefly used. It has been coloured with acetate of copper, also with a mixture of indigo and gamboge." Acetate of copper and gamboge are not desirable for ingestion; but we doubt whether they can greatly add to the deleterious properties of absinthe.

On facitious wines, Dr. Prescott remarks very justly, "The artificial production of wines is not, like that of brandy, a task which chemical skill can hope to accom-

plish. Besides the great complexity of the ethers, the solid 'extractives' are requisite. Then the peculiarity—in many cases the commercial value—of an actual wine depends upon certain proportions of the constituents named above, which proportions the chemist cannot fully determine. The ethers of wine elude quantitative analysis. Moreover, there are doubtless substances in wine not identified. It may be perfectly true that a mixture of pure alcohol, water, glucose, bitartrate, and ethers may be made in such carefully-adjusted proportions that it will probably be capable of producing whatever effect wine would produce upon the system; and, indeed, may be less objectionable for administration, more agreeable, and (when offered as wine) more saleable, than are many grades of actual wine; yet such a mixture is not actual wine, and should not be presented as such."

The distinction between sedimentary and surface fermentation is briefly but clearly explained. A report is mentioned that at present colchicum seeds are used in Germany as a substitute for hops—a most reprehensible fraud. The presence of strychnia in beer is declared "improbable." "The drinking at one sitting of one to two pints of beer rendered 'suitably bitter' by strychnia would, according to Hassall's data, in most cases bring the beverage under immediate legal investigation." Dr. Prescott holds, however, "that there is no physical difficulty in its being held in solution in beer." It has been declared that strychnia would be precipitated by the tannin of the hop. But this constituent does not remain in beer. "Moreover, the insolubility of tannate of strychnia in 20,000 parts of water is by no means assured, and with the solvent action of acetic acid, as in beer, is quite improbable."

For the processes given for determining the constituents of fermented and distilled liquors, we must refer our readers to the work itself, remarking that this little volume will prove highly useful to the public analysts.

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The recent mineralogical correspondence in your journal has given rise to a good deal of reflection. I have re-perused the whole of it, and have been thinking as follows:—

How comes it that so many palpable errors have crept into the science of Mineralogy?

How is it that much ready assent has been given to that which is not truth?

Can it have been through want of proofs of things that are not extant? Or, of things that are extant, but have not yet been acquired, through lack of diligent search, as to their whereabouts?

It cannot possibly be through want of *skill* to use proofs in possession.

Can it be any lack of *will* to use proofs at command, through jaundiced prejudices of education or of anything else equally barbarous? One can hardly think so.

Or, has *probability* been intruding without proper introduction, so that doubtful or false propositions have been quietly allowed to usurp the place of right principles? Partly so, it may be.

Can it be that received hypotheses have been thoughtlessly relied upon as infallible conclusions? As likely as not. Or, have students (most of them) all along the line been blindly submitting to what is called *authority*?—a term, by the way, of exceeding delicacy; the submission to which, as a rule, implies a sort of lazy assent to received opinions upon certain matters that have never yet been fully investigated.

If this be the case, and it must be confessed that it

looks very like it, the axe may as well be vigorously applied to the root of the tree of evil at once; for it has kept many of us in ignorance and incapacity quite long enough.

True loyalty means submission to *reasonable* authority; and that which is truth ought to be able to stand all sorts of testing without wincing.

My observations on the 3rd inst. touching certain minerals promptly brought me from two respectable sources the particulars I desired. A strong proof (if I required one) that there is no lack of the true Freemason spirit current amongst those who are lovingly addicted to mineralogical pursuits, and that it only wants a very little canal-cutting for it to flow in. Alas! but what must I say?

The chemical formulæ sent me *are not identical!* By no means a novelty; but this "trifling" fact induces me to remark again that if we had a mineralogical society, all new authenticated facts might find a sanctum in its records, and with obvious advantages.

Strange to tell, mineralogy has for a long time been most unrighteously pooh-poohed by many who ought to have known better. They did know better then. They know better now. They are beginning to allow that the neglected science holds rank of importance. Small condescension this considering its respectability; for it has nothing *mean* about it, and it is both captivating and elevating. Moreover, it has fewer jealousies and thwarting interests surrounding it than several of the natural sciences that might be mentioned. It does not at all clash with what are called the older sciences. It does the reverse of this. It claims the very closest relationship with several of the more prominent sciences. It is the intimate of everything and the friend of everybody. Its study has the singular merit of recommending itself. "In its shallows a child can wade, and in its depths a giant may swim." In fact, it is a deliciously delightful story that is without an end.

Mineralogy wants, in the first place, all the rubbish taken out of its nomenclature, and then to make a fresh start.

Everybody knows who David Page is. Hear what David Page says:—

"As yet the science of mineralogy, notwithstanding the sound progress which has been made of recent years, is in a very unsatisfactory state—cumbered by synonyms, overloaded with sub-divisions into so-called '*species*,' and devoid of that unity of nomenclature which makes the terms employed express a portion of the information attempted to be conveyed."

It is sad to be obliged to acknowledge that mineralogy is not at present an exact science.

Medicine was not an exact science once. But as recently as 1868 the medical profession established a new society for the purpose of enquiring into the action of drugs! Rather late in the day some may say.

The inaugural address was given by no less a personage than Sir Thomas Watson, Bart., M.D.

In it he said, in courageous, simple honesty:—

"We know tolerable well *what* it is that we have to deal with; but we do not know *how* to deal with it." We want to learn distinctly what is the action of drugs and of other outward influences upon the bodily organs and functions. To me it has been a life-long wonder, how vaguely, how ignorantly, how rashly drugs are prescribed. We try this, and not succeeding, we try that; and, baffled again, we try something else: and it is fortunate if we do no harm in these our tryings. Now, this random and haphazard practice, wherever and by whomsoever adopted, is both dangerous in itself and discreditable to Medicine as a science. Our profession is continually fluctuating on a sea of doubt about questions of the gravest importance." (See *Lancet*, Jan. 18, 1868.)

I may be told that the cases are not parallel; perhaps they are not exactly? but permit me very earnestly to ask whether the mineralogists of this day profess less

moral courage than the physicians of that day? I do not think so. They possess at least as much, and that will suffice for the purpose. We want a new society to do away with the random and haphazard practice wherever and by whomsoever adopted, which has been so long inimicable to everybody's convenience and comfort.—I am, &c.

T. A. READWIN.

Liverpool, Sept. 10, 1875.

MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

To the Editor of the Chemical News.

SIR,—Mr. Readwin objects to the *limitation* of the title of the new society, and wants it to be *cosmopolitan*. I sincerely hope it may become so, but in the meantime would remind him of its *breadth*.

I do not happen to have here the full titles of all the societies he refers to, but the *Geological Society of London* is the full title of one of them, and certainly the proposed title is larger than this.

The Geological Society of London is supplemented by other Geological Societies—in Cornwall, Manchester, Liverpool, Yorkshire, Glasgow, Edinburgh, Dublin, and elsewhere. All these localised societies are doing good work, and I think it would be a great misfortune for them to be amalgamated with the Geological Society of London. The case is, however, different with Mineralogy, as mineralogists are much less numerous than geologists, so that it occurred to me that all local work might be brought into a common focus by arranging local meetings of sections appointing their own local Secretaries, wherever a few working mineralogists could be got together.

Mr. Readwin truly remarks that "British and Irish mineralogists have intelligent friends all over the world," and it is hoped that these will become *corresponding members*. However, all such matters of detail as title, rules, &c., will be best settled by the votes of the first fifty members, and I trust this number will be completed in a very short time.—I am, &c.,

J. H. COLLINS.

Truro, September 18, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 7, August 16, 1875.

Ninth Note on the Electric Conductibility of Bodies Moderately Conductive; Electric Polarisation of Minerals.—M. Th. du Moncel.—In two memoirs presented to the Academy on October 5 and 26, 1874, the author called attention to the fact that electric conductivity through mineral matters is most frequently accompanied with very energetic effects of polarisation, the result of which is sometimes to weaken successively, and in enormous proportions, the electric current which traverses them; sometimes to augment it by degrees, sometimes to weaken it at first and increase it subsequently. He attributed at first these effects to local actions developed in the interior of the stones under the influence of the current which traverses them, which actions combining with the effects of polarisation may, up to a certain point, explain the effects observed. But what is the nature of these local actions? This remained to be explained, and the author caused a certain number of specimens of stones of different kinds to be cut with much care in order to study them under this especial point of view. One of these specimens, remarkable on account

of the effects which it presents, has thrown a very distinct light on this matter, and brought to day certain novel and very interesting phenomena. It is a grey quartz, found in the limestone quarries of Héronville, near Caen. The author has had cut from this stone a small prism, 38 m.m. in length, 24 in width, and 5 in thickness. It has been polished on two sides, and it has only been experimented upon after having been kept for seven months in a very dry place. In spite of its dryness, the conductivity of this stone was so great that to determine the variations of the current which traversed it he was obliged to connect the ends of the wire of his galvanometer, of 36,000 spiral folds, by a derivation of 4 kilometres of resistance. The effects produced by the stone in question were quite peculiar, both as regards the strength and the duration of the current of polarisation. It appears that effects of polarisation exist in most minerals, and that these effects may even sometimes give rise to secondary currents relatively intense. If the electric conductivity across stones was merely the result of an electrolytic conductivity occasioned in the midst of a moist conductor, these effects might be explained by the intervention of local pre-existing couples. But with stones so hard and dry it is difficult to admit the presence of this moist conductor, and we are naturally led to refer the polarisation in question to the electrification of the bodies in the electrotonic way, and under the influence of effects of condensation.

Reducing Action of Hydriodic Acid at Low Temperatures upon the Ethers, properly so-called, and the Mixed Ethers.—M. R. D. Silva.—From his experiments the author considers himself enabled to deduce the following propositions:—1. When hydriodic acid gas reacts upon an ether, properly so-called, between zero and +4°, the hydrogen of one molecule of gas and one of the hydrocarbon groups of a molecule of ether are exchanged in the two molecules, the result being an alcohol and the corresponding ether. 2. When the hydriodic gas reacts upon a mixed ether, between 0° and +4°, the hydrogen of one molecule of the gas, and the hydrocarbon group less rich in carbon of one molecule of ether, are interchanged in the two molecules. There is formed the alcohol corresponding to the hydrocarbon group more rich in carbon, and the iodide of the alcohol corresponding to the hydrocarbon group less rich in carbon. 3. All the mixed ethers, of which one of the monatomic hydrocarbon groups is methyl, are transformed under the influence of hydriodic gas between 0° and +4° into iodide of methyl and an alcohol corresponding to the other hydrocarbon group of the ether.

Synthetic Researches on the Uric Group.—M. E. Grimaux.—The author on a former occasion (*Comptes Rendus*, lxxxii., No. 7, 1875) made known certain uric derivatives from asparagin, namely, malyureic amide and malyureic acid, and indicated the formation of three new bodies obtained by the action of bromine upon this acid in presence of water. In pursuing these researches two new bodies have been discovered on studying the action of dry bromine upon malyureic acid.

Analysis of the Gases Evolved in the Island of Saint Paul.—M. Ch. Velain.—The gas disengaged on the north of the landing-place, where abundant and continuous fumeroles are found on the shore, has a temperature of 78° to 80°, and the following composition:—

| | | | | |
|---------------|----|----|----|-------|
| Carbonic acid | .. | .. | .. | 14.24 |
| Oxygen | .. | .. | .. | 17.01 |
| Nitrogen | .. | .. | .. | 68.75 |

100.00

Fourth Note on Processes of Magnetisation.—J. M. Gaugain.—The process of magnetisation known as double touch may be analysed in the same manner as that of single touch.

Researches on Tempered Glass.—V. de Luynes and Ch. Feil.—The fracture of blocks and plates of tempered

glass, varying in form and size, presents an analogy to that of Prince Rupert's drops, both in the circumstances under which it is produced, and in the form and arrangement of the fragments derived from the rupture of the glass. In general, it is not possible to cut a piece of tempered glass with the saw, the drill, or the file without its bursting into shivers. In some cases, however, the operation is practicable. Thus a disc may be pierced at its centre without bursting, but it breaks up if perforated in any other point, or if sawn along a diameter. A square plate of glass of St. Gobain, when tempered, shows on examination with the aid of polarised light a black cross, the limbs of which are parallel to the sides of the square. In these directions the plate may be cut without bursting. But without these lines, whether parallel or transversely to their direction, it cannot be cut or pierced without a rupture.

Certain Double Metallic Sulpho-Carbonates.—M. A. Mermet.—The author has obtained well defined crystals by combining the alkaline sulpho-carbonates with those of the heavy metals. He has isolated the crystals of the double sulpho-carbonate of potassium and nickel.

Reagent Proper for Detecting the Sulpho-Carbonates in Solution.—M. A. Mermet.—A recent and dilute solution of the nickelate of ammonia is recommended. Pour into a test-tube a few drops of solution of nickel sulphate or chloride; add excess of ammonia and water until the mixture, on agitation, becomes colourless. A few drops of the solution of the sample in question are then added. If even a trace of sulpho-carbonate is present, a gooseberry-red is obtained. Alkaline monosulphides give a brown or black shade.

No. 8, August 23, 1875.

Compound of Platinum, Tin, and Oxygen analogous to the Purple of Cassius (Platino-Stannic Oxide of M. Dumas).—MM. B. Delachanal and A. Mermet.—It is stated in treatises on chemical analysis that if we mix solutions of bichloride of platinum and protochloride of tin a brown tint appears, but no precipitate. This statement is correct; but if the solution is diluted with much water, and boiled, a brown substance separates out, which, after being washed for a long time with hot water, no longer contains chlorine, but merely oxygen, platinum, and tin. This interesting compound is, like the purple of Cassius, a hydrate, and shows, like the same compound, a composition varying according to the circumstances under which it has been produced. It has been obtained, not merely by the process mentioned above, but by placing a sheet of tin in a solution of bichloride of platinum: the liquid takes a dark colour, and a precipitate is formed, which increases much if the liquid is diluted with water and boiled. This procedure, as is well known, yields under analogous conditions the purple of gold. The substance which the authors describe dissolves in vitreous fluxes, giving them a greyish tint. At 100° it loses water, and if calcined it experiences a further loss of weight, which should correspond to an escape of oxygen. Under the microscope it appears in the form of amorphous granules, translucent and yellowish. Boiling alkalies and aqua regia attack it; alkaline carbonates at the heat of fusion form a stannate and platinum in a state of division. The product obtained by mixing the two solutions of platinum and tin was found to consist of—

| | |
|------------------|-------|
| Oxygen | 28.51 |
| Tin | 60.00 |
| Platinum | 11.49 |

That prepared by immersing metallic tin in the bichloride of platinum gave, when dried at 160° C.,—

| | |
|------------------|-------|
| Oxygen | 27.31 |
| Tin | 55.50 |
| Platinum | 17.19 |

100.00

Oil of Bankoul.—M. E. Heckel.—The author dissents from certain views put forward by M. Corenwinder in his paper of June 28th. He maintains that the oil of bankoul is little more purgative than that of sweet almonds. He states that the oil was used in New Caledonia for the lamps in a lighthouse, but that it corroded the metal jets, even those of platinum. M. Heckel was requested by the local government to undertake its purification, but did not succeed.

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. vi.

Defence of the Old Theory of Electrostatical Induction.—G. Pisati.—Not adapted for abstraction.

Chemical Decomposition: Dissociation applied to the Interpretation of certain Volcanic Phenomena; Synthesis and Analysis of a New Mineral from Etna, and of Common Origin in Volcanos.—O. Silvestri.—The author, on passing perfectly dry ammoniacal gas through a red-hot platinum tube, obtained at the other end a gas having all the characters of nitrogen mixed with a trace of hydrogen. The ammonia had been dissociated by the heat, and the hydrogen had passed through the pores of the tube. On repeating the experiment in a platinum tube filled with coarse fragments of recent lava from Etna, a small quantity of hydrogen escaped at the other extremity, the nitrogen having become fixed in the lava, and the greater part of the hydrogen having escaped as before. Iron heated, in contact with ammoniacal gas, increases in weight by 6 per cent. The fixation of the nitrogen is due to the formation of a nitride of iron, specimens of which were obtained after the recent eruption of Etna, and found to consist of—

| | |
|------------------|--------|
| Iron | 90.859 |
| Nitrogen | 9.141 |

100.000

Peroxide of Iron as a Generator of Nitric Acid, and on the Origin of Nitre in some Experiments of Cloëz.—Dr. Leone Pesci.—The author's results are: that sesquioxide of iron is capable of nitrifying ammonia; that, as Prof. Selmi holds, the first step in nitrification is probably the formation of nitrous acid; that this oxidation is effected by the sesquioxide of iron, not as a porous body, condensing oxygen from the air, but giving up oxygen of its own as proved by its reduction out of contact with the air; if exposed to the air the sesquioxide is not reduced since the oxygen withdrawn is replaced from the atmosphere. This explains the fertilising action of compounds containing peroxide of iron. Hence also ochraceous limes are preferable for artificial nitre-beds. Lastly, in the experiment of Cloëz, ammonia was evolved, to the oxidation of which rather than to the direct oxidation of atmospheric nitrogen must be ascribed the formation of nitric acid.

Oleandrine and so-called Pseudocurarin.—Dr. Ciro Bettelli.—Cattle having been poisoned by eating oleander-leaves, the author made an investigation of oleandrin and pseudocurarin, two poisonous principles present. Oleandrin with concentrated sulphuric acid gives a splendid orange colour, which on the application of heat passes into a violet-red. With sulphuric acid and bichromate of potash it gives first an orange, then a yellowish green, and finally an emerald green, which remains for some time. With sulphuric acid and ceric oxide it gives an orange which passes into violet.

Concurrence of Albumen in Rendering Tricalcic Phosphate Soluble in the Blood.—M. Mercadante.—The author concludes that the solubility of phosphate of lime in the blood results not from the presence of one substance, but is the result of a mixture of bodies.

Presence of Leucin in Tares.—A. Cossa.—The author finds that leucin is a constant ingredient in tares grown in the dark.

Bulletin de la Societe Chimique de Paris,
Nos. 4 and 5, September 5, 1875.

Researches on the Constitution of the Albumenoid Bodies.—M. Schutzenberger.—Seeing the almost complete identity of the numbers found in the elementary analysis of the amidated mixtures furnished by the principal albumenoid bodies, and leaving on one side vegetable fibrin which offers certain peculiarities requiring further investigation, we may admit as extremely probable that these mixtures are similarly constituted, not merely qualitatively, but also quantitatively. We arrive thus at the conclusion that the albumenoid bodies have really a common nucleus, having an identical constitution in each case. The differences observed between the albumenoid bodies would then depend on the nature and proportion of the secondary principles grouped around this nucleus. This view resuscitates, under a more precise form, the old protein theory of Mulder, with this distinction—that we can now give an account of the constitution of the common nucleus. Ossein, gelatin, belongs evidently to another type, and the nucleus, though analogous, is not identical.

Combination of Methylic Oxide and Hydrochloric Acid.—M. C. Friedel.—Already noticed.

Table for the Transformation of Specific Gravities.—A. Theunis.—The table in question is not inserted.

Baryta Green.—To a mixture of 2 parts of caustic soda and 1 part chlorate of potash are very gradually added 2 parts of manganese in fine powder. The temperature is finally raised to incipient redness. The mass is then allowed to cool, powdered, and exhausted with water, and to the green filtrate is added a solution of nitrate of baryta. Manganate of baryta of a fine violet colour is deposited, and is washed with care. This substance when dry is treated with from $\frac{1}{2}$ to 1 part of hydrated baryta, and heated gradually to incipient redness, with constant stirring. The mass when cold is of a fine green. It is then powdered and washed, to remove any excess of baryta.

M. Reimann's Farber Zeitung,
No. 32, 1875.

Refuse Waters from Cloth Manufactories.—The waters in question are derived from fulling and rinsing woollen cloths, and are estimated to contain the oil used in spinning, to the amount of 15 per cent of the weight of the wool, and the soap employed in fulling, which is 30 per cent of the weight of the cloth. The author recommends that these waters should be collected in appropriate tanks, precipitated with milk of lime, and that the lime soaps thus formed should be decomposed with sulphuric acid. The total waste for the whole of Europe is estimated at 2,125,000 cwts. of fatty matters.

Importance of Chalk in Madder Dyeing.—The writer points out that by the addition of chalk to a mixture of alizarin and purpurin, any desired tone may be produced, though with loss of the one or the other colouring matter. Hence it appears why the same sample of garancin, or fleur de garance, will produce a good red, with little chalk, or a good purple with much chalk. If a mixture of alizarin and purpurin is treated with an alkaline solution at 200° in a closed vessel, more alizarin is obtained than purpurin. In this manner the purity of a purpurin may be recognised, and pure alizarin can be obtained from the ordinary alizarin of commerce. The preparation of pincoffin depends on the destruction of the purpurin, which explains its low tinctorial power, and the fact that it is much better adapted for purples than for reds.

This issue further contains recipes for a finishing for mixed satins; a lead colour and a fast Bismarck brown, for wool; a brown, an orange, a ponceau, and a scarlet, for woollen printing; a deep blue on an indigo bottom, for cotton drills; and a light and dark rust yellow for cotton yarns.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 17, August 26, 1875.

This issue mentions the death of Prof. von Schroetter, Director of the Viennese Mint. As this distinguished chemist died April 15th, the announcement is somewhat late.

The Academy of Sciences of Vienna is occupied with the question of the decrease in the quantity of water in springs and rivers. During a certain number of years there has been a decrease in the waters of the Danube.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, May and June, 1875.

On an Electrolytic Method applied to the Determination of Certain Metals, and on the Thermo-Electric Battery of Clamond.—Oscar Loiseau.—This valuable paper would be unintelligible without the accompanying illustrations.

MISCELLANEOUS.

Chemistry in Australia.—Mr. R. W. Emerson MacIvor, F.C.S., Assistant to the Professor of Scientific Chemistry at the Andersonian University, Glasgow, has been appointed Lecturer on Agricultural Chemistry to the districts of West Bourke and Ballyratt, Victoria, Australia.

Miners' Association of Cornwall and Devon.—In order to stimulate research, experiment, and invention, and to promote the advancement of mining enterprise in Cornwall and Devon, Mr. G. L. Basset, of Tehidy, offers a prize of £50 for the discovery of a new mineral, in Cornwall or Devon, which is deemed likely to become commercially valuable: an accurate analysis and a description of the leading physical properties and distinguishing characteristics of the mineral to be given, specimens to be handed to the Committee, and the locality and mode of occurrence to be distinctly described. For the invention of a method—mechanical or chemical—of making marketable, with commercial advantage, ores or minerals produced in Cornwall or Devon, and hitherto regarded as worthless or of little value, the method being clearly described, and specimens of the product in its several stages being handed to the Committee; or—For the discovery of some new application of a mineral substance already known to occur in Cornwall or Devon, either by itself or in combination, to some useful purpose, so as to render it of marketable value, or materially to enhance its value if already marketable to some extent, Mr. Basset offers a prize of £100. Communications may be addressed to Mr. J. H. Collins, F.G.S., 57, Lemon Street, Truro.

NOTES AND QUERIES.

Test for Free Acid in Coal-Gas.—Can your readers inform me, through the medium of your paper, whether there is any test for free acid that can be used in gas-light when it is impossible to distinguish the colour of litmus-paper?—W. S.

Commercial Phosphates.—You would, I believe, confer a very considerable favour on provincial chemists like myself, who were unable to attend the late meeting of the British Association, if you could find space in an early issue of the CHEMICAL NEWS for the Report of the Committee on Commercial Phosphates and Potash Salts.—ANALYST.

[This Report is already in the printer's hands. The first part will appear in our next number.—Ed. C.N.]

Chrome-Iron Alloy.—(Reply to G. G. B.)—It is evident from article (CHEM. NEWS, vol. xxxii., p. 136) that the use of chromate of iron in the manufacture of speigeleisen is a mere experiment, and G. G. B. must wait some time before he will get much more information on the subject. Chrome-iron ore, $\text{FeO}, \text{Cr}_2\text{O}_3$, being composed of—

| | |
|---------------------------|--------------|
| Oxide of chromium | 69 per cent. |
| Oxide of iron | 31 " |

100

is abundant in Nature, and exists in France, Norway, Silesia, Maryland, Pennsylvania, Baltimore, and St. Domingo. It has been found in Banffshire and Stirlingshire.—DERSUNTHAL.

THE CHEMICAL NEWS.

Vol. XXXII. No. 827.

CHEMICAL AND SPECTROSCOPIC CHARACTERS OF A

NEW METAL, GALLIUM, DISCOVERED IN THE

BLENDE OF THE MINE OF PIERREFITTE, IN THE VALLEY OF ARGELES, PYRENEES.

By M. LECOQ DE BOISBAUDRAN.

BETWEEN three and four in the evening of August 27, 1875, I found indications of the probable existence of a new elementary body in the products of the chemical examination of a blende from the mine of Pierrefitte. The oxide, or perhaps a sub-salt, is thrown down by metallic zinc in a solution containing chlorides and sulphates. It does not appear to be the metal itself which is reduced by the zinc. The chloride is precipitated by a small quantity of ammonia. In a mixture containing an excess of zinc chloride, the new body is thrown down before the zinc if the liquid is treated with an insufficient quantity of ammonia. From the second precipitate the proportion becomes trifling, almost all the new body being found in the first fraction. Even in the conditions which should correspond to a state of peroxidation, the oxide is soluble in an excess of ammonia. Its salts are thrown down by sulph-hydrate of ammonia, an excess of which does not perceptibly re-dissolve the sulphide formed. The salts are also precipitated by sulph-hydrate of ammonia in presence of acetate of ammonia and of an excess of free acetic acid. In presence of zinc the new body is concentrated in the first sulphides deposited. Yet six successive precipitations are required to remove entirely the sulphide of zinc. The salts are not precipitated by hydrosulphuric acid in solutions slightly acidulated with hydrochloric acid. The oxide re-dissolves in an excess of carbonate of ammonia along with zinc. The extremely small quantity of the substance at my disposal did not permit me to isolate the new body from the excess of zinc accompanying. The few drops of zinc chloride in which I concentrated the new substance gave under the action of the electric spark a spectrum composed chiefly of a violet ray, narrow, readily visible, and situate at about 417 on the scale of wave-lengths. I perceived also a very faint ray at 404.

An additional note presented to the French Academy, contains the following details:—"The experiments executed since August 29, confirm me in the view that the body in question is a new element for which I propose the name Gallium. The sulphide is really insoluble in hydrosulphate of ammonia. I have obtained the chloride in such a state of concentration that the ray 417 is very brilliant under the action of the induction spark. The chloride gives the ray 417 in a gas flame, but more feebly. The salts are easily precipitated in the cold by carbonate of barium. In a mixture with a large excess of zinc chloride the new substance is thrown down by hydrosulphate of ammonia along with the first portions of zinc sulphide. Repeated evaporations with large excesses of *aqua regia* do not appear to occasion any loss from volatilisation of the chloride. The sulphide seems to be white, like that of zinc, a point to be decided after complete purification of the body. If hydrated zinc chloride containing traces of the new substance is heated to the point where a small quantity of oxychloride of zinc is formed, all the gallium remains in the insoluble state, probably as oxychloride. The spectrum is more brilliant with a spark of moderate length than with a very short spark.

REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

THE Committee was of opinion that the objects for which it was appointed would be best attained by ascertaining as fully as possible the details of the methods of examining phosphates and potash salts in general use, and learning the opinions of the chemists employing them as to their special advantages and limits of error, at the same time collecting information on other closely related matters.

With the view of carrying out these intentions to the fullest possible extent, the Committee issued a circular-letter setting forth their aims and objects, and sent it to every member of the Chemical Society, to all gentlemen known to be interested in the subject, and to such chemists as your Committee learnt would be likely to afford assistance.

Together with the above circular-letter the Committee forwarded a series of very carefully arranged questions, with the view of indicating the exact nature of the information they were in need of.

No effort has been spared to make the objects of the Committee widely known, and nearly a thousand circulars have been distributed. In the case of chemists known to have special knowledge of the subjects on which information was desired, the circulars were accompanied by manuscript letters from the Secretary, requesting careful consideration of, and full replies to, the queries. In answer to their request for information, the Committee has received contributions from a considerable number of chemists, both in England and on the Continent, the answers in many cases containing much original information, and being generally of the utmost value in enabling the Committee to form an opinion on the present state of the questions which it was appointed to consider and report on. On receipt of the replies a further correspondence was in many cases entered into by the Secretary, with the view of obtaining explanation of, or further information upon, doubtful points, and every means has been taken to elicit the views of correspondents.

The following is an alphabetically-arranged list of chemists to whom the Committee is indebted for information:—

- Berrand, Dr. G., Manager of the United Chemical Works of Leopoldshall.
- Bloxam, C., Professor of Chemistry, King's College, London.
- Blunt, T. P., County Analyst for Shropshire, &c.; Chemist to the Shropshire Chamber of Agriculture.
- Brown, Campbell, D.Sc., Lecturer on Chemistry at the Liverpool Infirmary School of Medicine; Public Analyst for Liverpool.
- Burnard, C. J., senior partner of the firm of Burnard, Slack and Alger.
- Cameron, C. A., M.D., Professor of Chemistry Royal College of Surgeons Ireland; Analyst to Royal Agricultural Society of Ireland, City of Dublin, &c.
- Cammack, J., Analyst to Bridgewater Chemical Works, St. Helens.
- Church, A. H., M.A. Oxon., Professor of Chemistry R. A. College, Cirencester.
- Cowan, W. M., Public Analyst for Greenock.
- Cox, J., late Chemist to Nottingham Mills Manure Co.
- Cruse, V., Chemist to Messrs. E. Packard and Co., Ipswich.
- Fairley, T., Consulting Chemist to Yorks Agricultural Society; Public Analyst for Leeds.

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman, James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

Flight, W., D.Sc., Assistant Examiner in Chemistry, London University.
 Franz, W., Chief Manager of the United Leopoldshall Works, Wiesbaden.
 Fresenius, C. R., Author of "Handbook of Chemical Analysis."
 Galbraith, W., late Chemist to Phospho-Guano Co., Liverpool.
 Hamlet, W. A., Analyst to Peruvian Government Guano Co. Agency.
 Hughes, J., Lawes Chemical Manure Co., Deptford and Barking.
 Joulie, H., Paris.
 Kitchen, A., Whitehaven.
 Lansdell, M. J., of Messrs. J. C. Nesbit, Lansdell, and Co., London.
 Leisler, Bock, and Co., Glasgow.
 Lichtenstein, M., London.
 Lupton, S., The Harehills, near Leeds.
 Newton, Keates, and Co., St. Helens.
 Ogilvie, T. R., late Public Analyst for Greenock.
 Parnell, E. W., Desoto Alkali Works, Widnes.
 Prentice, M., jun., Stowmarket.
 Pattinson, J., Public Analyst, Newcastle-on-Tyne.
 Reddrop, T., Chemist at L. and N. W. R. Company's Works, Crewe.
 Rosenthal, Dr. G., Chemist to Messrs. Holloway Bros.
 Ruffle, J., late Assistant to Dr. Voelcker and to Dr. F. C. Calvert.
 Sibson, A., Analytical Chemist, London.
 Ulex, Dr. G. L., Hamburg.
 Wallace, Tatlock, and Clark, Joint Public Analysts for the City of Glasgow.
 Warrington, R., formerly Chemist to J. B. Lawes and Co.
 Williams, W. J., Chemist in charge of Phosphate Sewage Company's Works at Hertford.

It will be observed that in almost every case the replies have been from chemists having special experience in the analysis of commercial phosphates or potash salts, and their communications contain in the aggregate an amount of information on the subject probably far in excess of any previously collected.

With a few notable exceptions, the Committee has received assistance from all the best known authorities on the subject: a few of the leading chemists, known to have special experience of the kind required, have not responded to the Committee's request for information, though their assistance was most courteously sought by a special letter in each case.

The cause of the silence observed in the above-mentioned cases is probably similar to that which prompted the following reply from a well known firm of chemists, whose results were in some degree the cause of the appointment of the Committee.

" June 19, 1875.

" MR. Alfred H. Allen.

" Dear Sir,—We are in receipt of your favour relating to the examination of phosphates and potash salts, but we must decline to give you the information required, as we do not think ourselves called upon to publish our methods of analysis, which we have perfected after long and careful investigation, for the benefit of those who have not taken this trouble.—We are, dear Sir,

" Yours obediently, &c."

A French chemist of very high standing says he belongs to a class of chemists who cannot afford to work "*pour la gloire*," but must keep their methods—their only capital—secret.

It is evident that the interests of science would materially suffer if a similar system were adopted by many chemists; but happily the above answers stand in striking contrast to the generous and elaborate replies that have in many instances been sent to the Committee.

The answers received to the various specific questions put have shown, in a very striking manner, how very varying, and even irreconcilable, are the opinions held by

chemists on many of the points submitted for their consideration. On this account the Committee refrains for the present from expressing any definite opinions on the points in question; but, feeling that the communications received contain much information which should be at once in the possession of those interested, it begs leave to submit to the Association the following digest of the replies received up to the present time. The Committee has avoided, as far as possible, any specific mention of the sources of the various items of information, but has departed from this rule in cases in which the value of the information would have been seriously diminished if the authority on which it was quoted had not been given.

(To be continued.)

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA. No. IV.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(1). *Analyses of Native Wines of Virginia.* By R. M. COOPER, of Mayesville, South Carolina.

THE cultivation of the grape has assumed considerable importance in Virginia within the last few years, the fresh fruit being sent in large quantities to the markets of the larger cities further north, and the production of wine having also grown up at a rapidly increasing rate. In the absence of any analyses of these native wines, I proposed several months ago to have some specimens examined in this laboratory, with a view to fixing to some extent the character of the wine at present made, and in the hope of furnishing some information which may be useful in the improvement of the manufacture. I wrote to several persons engaged in this industry asking for samples of their products, and received in response the following, which were analysed by Mr. Cooper:—

(1). "Virginia claret."—A red wine, made from the juice of the "Alvey" grape, with no addition of spirit or sugar. From the Monticello Wine Company, of Charlottesville, Albemarle Co., Va.; Ad. Russow, superintendent.

(2). "Virginia hock."—White wine, made from first pressing of "Concord grapes," with no addition of sugar; vintage of 1873. From Monticello Wine Company.

(3). "Bacchantees."—Light red wine, made from pure juice of "Concord" grape; vintage of 1871. From the Laurel Hill Vineyard, Norfolk County, Va.; T. W. Lemosy, proprietor.

(4). "Concord" (or "claret").—A red wine of medium depth of tint, made from "Concord" grape. From the Belmont Vineyard, Front Royal, Warren Co., Va.; M. B. Buck, proprietor.

(5). "Sweet Concord."—Dark red wine, made from "Concord" grape, with the addition of some refined cane sugar syrup; vintage of 1871. From Laurel Hill Vineyard.

(6). "Ives" (or "claret").—Wine of fine, clear, red colour, made from pure juice of "Ives" grape. From Belmont Vineyard.

(7). "Delaware."—Very pale, bright, white wine, made from juice of "Delaware" grape, with addition of $\frac{1}{4}$ lb. of sugar to each gallon of must; vintage of 1873. From Monticello Wine Company.

(8). "Sweet Delaware."—White wine, made from "Delaware" grape, with addition of refined syrup; vintage of 1871. From Laurel Hill Vineyard.

(9). "Delaware" (or "hock").—Very bright white wine, made from pure juice of "Delaware" grape. From Belmont Vineyard.

(10). "Catawba" (or "hock").—White wine, made from pure juice of "Catawba" grape. From Belmont Vineyard.

(11). "Norton's."—Very dark purple-red wine, made from "Norton's Virginia" grape (said to be an indigenous seedling), with no addition of sugar or spirit; vintage of 1873. From Monticello Wine Company.

(12). "Dry Norton's Virginia."—Deep red wine, said to have been made from pure juice of "Norton's Virginia" grape, with no addition to must. From Laurel Hill Vineyard.

As regards the method pursued in the analyses,—

The alcohol was determined by careful distillation after dilution with water, neutralisation with sodium hydrate, and addition of a little tannic acid to prevent foaming; the specific gravity of the distillate and its absolute weight being finally taken.

For the volatile acids, the wine was neutralised with sodium hydrate, alcohol distilled off, excess of phosphoric acid added, and the distillation repeated, the second distillate being then neutralised with standard lime-water, with rosolic acid as the indicator.

The total acid was determined by dilution and neutralisation with standard solution of base, both lime-water and ammonia being used, with hæmatoxylin and rosolic acid, respectively, as indicators.

Non-volatile acid was found as the difference between the volatile and total acid.

Glucose was determined by means of Fehling's copper solution. Unaltered cane sugar was tested for, but in no instance found.

Tannic acid was estimated by the method of Maumené, viz., addition to wine of a little alcohol, then excess of baryta-water and a little ammonium chloride, warming gently, filtration, washing of precipitate with alcohol, followed by water, solution of precipitate in dilute sulphuric acid, and titration with indigo-carmin and potassium permanganate.

The total dry residue was obtained by cautious evaporation and drying at 110° C.

A separate portion of wine was evaporated to dryness, with addition of a little barium sulphate to enable the residue to be removed from the vessel, and nitrogen determined by combustion with S. W. Johnson's mixture of sodium carbonate and calcium hydrate.

The former portion of dry residue was burnt at as low a temperature as possible, and the ash weighed.

Potassium, present in the ash mainly as carbonate, was determined as platino-chloride.

The following were the results obtained, expressed in percentage, by weight:—

Detailed information as to the history of each specimen of wine was asked for, including the natural conditions of growth, method of culture, precise steps of manufacture, &c., but the replies were too incomplete to furnish satisfactory data for fully criticising the above results. On the whole, it would seem that two points chiefly deserve attention:—

(1). The rather irregular alcoholic strength of wine made from the same grape appears to indicate that due attention is not yet given to the full ripening of the fruit and its careful selection in gathering, ripe and unripe and partially decayed grapes being to too great an extent mixed together in the vat.

(2). The total amount of acid is pretty high, though not excessively so, and, in some instances at least, too large a proportion of this consists of the volatile acids, whose presence in large amount is suggestive of commencing unsoundness.

These wines are all comparatively new, and, in view of the somewhat considerable amount of nitrogenous matter present, greater care seems to be needed in the after stages of fermentation and clearing, involving the use of perfectly clean vessels, exclusion of air, &c.

The statements of the producers as to use or exclusion of sugar added in the manufacture are fully borne out, except in the case of No. 12, in which, notwithstanding the fact that "Norton's Virginia" is naturally a somewhat heavy wine, the proportion of unfermented sugar is too large. As, however, the maker admittedly produces both pure and sweetened wine from the same grape, it is not unlikely that a sample of the one may have been accidentally sent instead of the other.

A comparison of the figures in the above table with one another, as regards several of the constituents—as, for instance, the ash and its contained potash—develops points of local interest, both in reference to the same grape at different places and different grapes produced at the same place.

There is no reason to doubt that grape culture in this State, already successful as regards the sale of the fresh fruit, offers much also of promise for the future in reference to the production with adequate care of sound, wholesome, and palatable wines.

(2). *Examination of amount of Bismuth present in various specimens of so-called Sub-Nitrate of Bismuth employed in Medicine.* By W. R. NELSON, jun., of Charlottesville, Va.

Some time ago I noticed the rather odd fact that "sub-nitrate of bismuth" for medical use, when of French manufacture, was sold here at a higher price than American,

| No. | Name and Source of Wine. | Specific Gravity at 15.5° C. | Absolute Alcohol, by weight. | Volatile Acid, calculated as Acetic Acid. | Non-Volatile Acid, calculated as Tartaric Acid. | Total Acidity, calculated as Tartaric Acid. | Sugar (Glucose). | Tannic Acid. | Solid Residue dried at 110° C. | Nitrogen. | Albumenoid Matter, calculated from Nitrogen. | Ash. | Potassium, calculated as Carbonate. |
|-----|--|------------------------------|------------------------------|---|---|---|------------------|--------------|--------------------------------|-----------|--|------|-------------------------------------|
| 1. | { Virginia claret—Alvey grape— Monticello Co. } | 0.9949 | 9.80 | 0.15 | 0.60 | 0.79 | 0.070 | 0.018 | 1.78 | 0.013 | 0.083 | 0.24 | 0.148 |
| 2. | { Virginia hock—Concord grape— Monticello Co. } | 0.9932 | 8.56 | 0.07 | 0.43 | 0.53 | 0.058 | 0.004 | 1.84 | 0.019 | 0.122 | 0.17 | 0.111 |
| 3. | { Bacchantes—Concord grape— Laurel Hill } | 0.9941 | 10.04 | 0.15 | 0.35 | 0.54 | 0.047 | 0.019 | 1.52 | 0.013 | 0.083 | 0.14 | 0.098 |
| 4. | { Concord—Concord grape—Bel- mont } | 0.9926 | 10.03 | 0.13 | 0.44 | 0.61 | 0.045 | 0.011 | 1.60 | 0.006 | 0.038 | 0.15 | 0.098 |
| 5. | { Sweet Concord—Concord grape—Laurel Hill } | 1.0050 | 11.79 | 0.39 | 0.17 | 0.66 | 3.152 | 0.006 | 5.11 | 0.006 | 0.038 | 0.13 | 0.111 |
| 6. | { Ives—Ives grape—Belmont .. Delaware—Delaware grape— Monticello Co. } | 0.9913 | 11.13 | 0.12 | 0.57 | 0.73 | 0.065 | 0.009 | 1.69 | 0.008 | 0.051 | 0.12 | 0.074 |
| 7. | { Sweet Delaware—Delaware grape—Laurel Hill } | 0.9931 | 9.46 | 0.10 | 0.41 | 0.55 | 0.075 | 0.008 | 1.98 | 0.014 | 0.090 | 0.24 | 0.160 |
| 8. | { Delaware—Delaware grape— Belmont } | 1.0117 | 10.57 | 0.56 | 0.01 | 0.72 | 3.703 | 0.006 | 6.41 | 0.009 | 0.058 | 0.17 | 0.111 |
| 9. | { Catawba—Catawba grape— Belmont } | 0.9875 | 12.69 | 0.08 | 0.41 | 0.52 | 0.106 | 0.002 | 1.42 | 0.016 | 0.102 | 0.12 | 0.086 |
| 10. | { Norton's—Norton's Virginia grape—Monticello Co. } | 0.9902 | 10.04 | 0.16 | 0.42 | 0.63 | 0.031 | 0.003 | 1.41 | 0.012 | 0.077 | 0.13 | 0.086 |
| 11. | { Dry Norton's Virginia—Nor- ton's Virginia grape—Laurel Hill } | 0.9953 | 10.57 | 0.22 | 0.48 | 0.76 | 0.112 | 0.019 | 2.66 | 0.018 | 0.115 | 0.31 | 0.234 |
| 12. | { Dry Norton's Virginia—Nor- ton's Virginia grape—Laurel Hill } | 0.9981 | 11.79 | 0.41 | 0.50 | 1.02 | 1.228 | 0.011 | 3.55 | 0.016 | 0.102 | 0.20 | 0.148 |

on the assumed ground of greater purity, while, on testing the two, I found the French preparation to be, in reality, not basic nitrate at all, but oxychloride, the American being what it professed to be.

Mr. Nelson undertook to determine the proportion of bismuth present in some specimens of material from the two sources named. The following are his results, two of the determinations being by another hand:—

| Manufactured or Sold by— | | Bismuth. Per cent. | Chlorine. Per cent. |
|---|------------|-----------------------|------------------------|
| Dorvault and Co., Paris | In drops. | 75.28 | 6.19 |
| E. Rousseau, Paris .. | " | 75.39 | 5.74 |
| Lazell, Marsh, and Gar- diner, New York .. | In powder. | 72.84 | } traces |
| Rosengarten and Son, | In drops. | 71.06 | |
| Philadelphia | In powder. | 72.46 | |

The French preparations were found to contain a little basic nitrate, but so little that the diminished percentage of bismuth, as compared with the pure oxychloride, which requires—

(For BiClO) { Bismuth 80.31 per cent,
Chlorine 13.57 ..

may be considered as essentially due to water retained. On the other hand, the much greater deficiency of chlorine as compared with the requirement of the formula is, doubtless, caused by the practice of saving bismuth by the addition of alkali to the water used for precipitation, leading to the presence of hydrate. The use of water of ammonia for this purpose is prescribed by the present United States pharmacopœia, and to this is partly due the fact that in the American preparations we find the percentage of bismuth intermediate between that of the normal basic nitrate—

$\text{Bi}(\text{HO})_2(\text{NO}_3)$ 68.62 per cent.

and of the hydrate—

$\text{Bi}(\text{HO})\text{O}$ 86.42 ..

(3). *Analysis of Crystallised Ammonium Oxalate from Guanapi Gnano.* By Dr. J. A. TANNER, jun., of Lynchburg, Va.

There is some little confusion observable in the published statements as to the occurrence of ammonium oxalate in Peruvian guano. The older analyses generally represent it as present. In the first Appendix to Dana's "Mineralogy" (1872), *oxammite* is mentioned amongst "other names given by Shepard for supposed new species consisting of oxalate of ammonia," In the second Supplement to Watts's "Dictionary of Chemistry" it is stated that, "according to Chevreul, the crystallisable material dissolved from guano by cold water consists mainly of ammonium oxalate mixed with yellow, red, and brown organic colouring matters." On the other hand, several of the older analyses do not mention the compound at all, or substitute calcium oxalate for it. And in the *Journal of the Chemical Society* for January, 1875, p. 100, among the salts found by E. Chevreul in his late minute examination of guano are quoted calcium oxalate and ammonio-potassic oxalate, but not the simple ammonium salt.

A manufacturing firm placed in my hands a year or two a lump of material of crystalline appearance, weighing something more than a pound, taken from a bag of Guanapi guano, which qualitative examination showed to consist of nearly pure ammonium oxalate without other bases. In order fully to settle the question of its identity, and of the occurrence of this salt ready formed in guano, Dr. Tanner made a quantitative analysis of picked crystals, which were, however, so small (generally 1 or 2 millimetres long) that it was impossible mechanically to get rid of the whole of the brown organic matter encrusting and lying between the colourless crystals themselves. This impurity also interfered with determination of crystalline form.

The ammonia was obtained by Schlösing's method—

expulsion by solution of sodium hydrate at ordinary temperature under a bell-glass, and reception in a known amount of standard sulphuric acid. Oxalic acid was precipitated by calcium acetate, and the calcium carbonate left on properly heating the precipitate weighed. Organic matter was left undissolved by the use of a small quantity of water.

Analysis gave—

| | | |
|---|---------|--------|
| NH_4 | .. .. . | 20.73 |
| C_2O_4 | .. .. . | 50.35 |
| Organic matter (with minute amount of ash) | | 5.54 |
| H_2O (by difference) | .. .. . | 23.38 |
| | | 100.00 |

Deducting the organic matter, we have—

| | | |
|------------------------|---------|--------|
| NH_4 | .. .. . | 21.95 |
| C_2O_4 | .. .. . | 53.30 |
| H_2O} | .. .. . | 24.75 |
| | | 100.00 |

The ordinary crystallised salt, $\text{C}_2(\text{NH}_4)_2\text{O}_4 \cdot \text{H}_2\text{O}$, requires—

| | | |
|------------------------|---------|--------|
| $(\text{NH}_4)_2$ | .. .. . | 25.35 |
| C_2O_4 | .. .. . | 61.97 |
| H_2O} | .. .. . | 12.68 |
| | | 100.00 |

while the normal salt, with two molecules of water of crystallisation, $\text{C}_2(\text{NH}_4)_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, requires—

| | | |
|------------------------|---------|--------|
| $(\text{NH}_4)_2$ | .. .. . | 22.50 |
| C_2O_4 | .. .. . | 55.00 |
| $2\text{H}_2\text{O}$ | .. .. . | 22.50 |
| | | 100.00 |

University of Virginia, August 20, 1875.

MAGNETISATION OF ILMENITE (TITANIC IRONSTONE).

By Dr. T. L. PHIPSON.

SOME fine specimens of ilmenite having been sent to my laboratory from Norway, it seemed a good opportunity to investigate the magnetic properties of this mineral. The composition of that which served in my experiments was:—

| | | |
|---------------------------|---------|--------|
| Titanic acid | .. .. . | 24.60 |
| Protoxide of iron | | 72.10 |
| FeS_2 | .. .. . | 2.06 |
| Manganese | .. .. . | trace |
| Silicic acid | .. .. . | 1.24 |
| | | 100.00 |

Its sp. gr. was 4.8, and it acted with tolerable energy upon the magnetic needle. From the inspection of this action I concluded that it was possessed of a very considerable number of poles in close proximity to each other, so that scarcely two closely adjacent parts acted in the same manner upon the north pole of the needle; hence it was evidently built up by a mass of crystals. An elongated rectangular piece of this mineral was separated by a blow of the hammer; it measured $1\frac{1}{2}$ ins. in length and was about $\frac{1}{4}$ in. broad. This was placed upon a table and submitted to magnetisation by friction with good magnets for upwards of an hour. It was then found to have a pole at each extremity, which it certainly had not before, and was accordingly suspended to a piece of silk, and hung up in a quiet corner of the laboratory. It pointed constantly towards the north, and returned to that position when deviated. It continued to do so for some weeks; but one morning I found it pointing east-west, or nearly so; it had lost its acquired magnetism entirely, having retained

it for rather more than a month. This loss occurred rather suddenly, and I am of opinion that it coincided with a magnetic storm of some intensity which happened about the time. If these experiments could be continued by some who have more time to devote to them, they might lead to some interesting results. It is possible that some minerals that show no action upon the needle might be made magnetic in the above manner.

THE ESTIMATION OF NITRITES IN WATER.

By EDWARD NICHOLSON.

THERE are two reactions, by the aid of which liberated nitrous acid may be estimated:—

1. The reducing action on potassium permanganate,
2. The reaction with potassium iodide.

The second reaction is by far the more sensitive; while 0.028 centigram. of nitrous acid in a litre of water only requires 0.01 centigram. of oxygen, yielded by 1 c.c. of the dilute standard permanganate solution, it liberates from potassium iodide 1.19 centigram. of iodine, a quantity sufficient for accurate estimation either volumetrically or colorimetrically. Besides the failure of the permanganate reaction (Péan de St. Gilles's process) in the case of minute quantities perfectly estimable by the iodine reaction, the former is masked or simulated by the action of organic matter. Dr. Paul recommends to use the permanganate after ridding the water of organic matter by alum precipitation and boiling; but I find this treatment will frequently leave, if not all the organic matter, at least sufficient to simulate much nitrous acid when none is present. Dr. de Chaumont proposes (Parkes's "Hygiene") a converse device, viz., to expel the nitrous acid by boiling the water after acidifying, and to take the difference between the quantity of permanganate now required, and that used without the boiling as indicating the amount reduced by nitrous acid; but it is evident, amongst other objections, that in few cases with the reaction with organic matter (already unsatisfactory in itself), either admit of such refinements or be clear enough for any value to be attached to the difference which may occur between the two experiments. But except in the case where sulphuretted hydrogen is present in water (and even then it can be removed) the well-marked and very sensitive reaction of nitrous acid on potassium iodide is always applicable. There are three processes available:—

1. *Volumetric Estimation by Arsenious Acid.*—This is an application of a well-known class of determinations; 198 of arsenious acid will absorb 508 of iodine, which amount is liberated by 12.2 of nitrous acid (12.5 is probably the more accurate figure, the proportion being as nearly as possible 40 to 1); it may be taken that each c.c. of a centinormal solution of arsenious acid (1.98 gramme per litre) will absorb the iodine liberated by 0.0125 centigram. of nitrous acid. I use the process in the following manner:—To 500 c.c. of the water, in a stoppered white bottle, add 5 c.c. of potassium iodide solution (one-tenth) and then 5 c.c. of dilute (one-tenth) pure sulphuric acid. Allow the reaction an hour for full development. If the iodine be liberated in very small quantity, or if it be masked by turbidity of the water, add a drachm of benzine or chloroform and agitate; the iodine will give it a pink colour which is quite as sensitive as the blue colour given by starch, and disappears more quickly when the iodine is absorbed. Under ordinary circumstances I use neither benzine nor starch, the yellow colour of the free iodine is sufficient. In order to estimate the iodine, neutralise the acid by a slight excess of sodium carbonate (caustic alkalies often contain nitrites), and drop in the centinormal arsenious solution until the iodine colour disappears.

2. *Mr. P. Holland's Colorimetric Process.*—This process is described in "Select Methods in Chemical Analysis." A solution of pure nitrite is prepared, con-

taining 0.01 centigram. of nitrous acid in each c.c. A solution of iodine (about 4 grammes per litre) in potassium iodide is also prepared, and adjusted of such strength that 10 c.c. made up to 200 c.c. with pure water shall produce the same colour as 10 c.c. of the standard nitrite solution made up to 200 c.c. with water containing potassium iodide and some dilute sulphuric acid. The iodine reaction being developed in a certain quantity of water containing nitrites (as in the preceding process) an equal colour is produced in an equal quantity of pure water by the addition of the standard iodine solution; each c.c. = 0.01 centigram. of nitrous acid.

3. *A Simpler Colorimetric Process.*—Mr. Holland's process adds two standard solutions to those used in water analysis, besides giving the trouble of obtaining a pure nitrite. I dispense with these additions by the following simple process. It is founded on the liberation of iodine by a permanganate* under the same circumstances as its liberation by nitrous acid; 0.01 centigram. of active oxygen contained in 1 c.c. of the dilute standard solution of permanganate commonly used (0.395 gramme per litre) liberates 0.16 (more correctly 0.159) centigram. of iodine; while 0.01 centigram. of nitrous acid liberates 0.40 centigram. of iodine under the same circumstances. The application of this principle to colorimetric estimation is obvious; 0.01 centigram. of active oxygen contained in 1 c.c. of the dilute standard permanganate solution will, in a comparative experiment, liberate the same quantity of iodine as 0.004 centigram. of nitrous acid. Let the iodine reaction be produced, as in the first process, in 500 c.c. of the water under examination. When the colour is fully developed add in the same way potassium iodide and sulphuric acid to 500 c.c. of pure water, and then drop in the dilute standard permanganate solution until an equal iodine colour is produced. The development of the colour is immediate.

The first process is well adapted for laboratory work, especially as the arsenious solution is useful for other purposes besides water analysis. The third process is hardly less accurate; I devised it for use while travelling in India, in order to reduce the number of standard solutions carried about.

Carlisle Castle, Sept. 23, 1875.

ON THE PURIFICATION OF CARBON DISULPHIDE.

By SERGIUS KERN, St. Petersburg.

ORDINARY carbon disulphide (CS_2) has a very disagreeable odour, owing to the presence of some hydrogen compounds which are formed during the preparation of the product by the action of nascent hydrogen on the carbon disulphide. Beside this the compound often contains free dihydric sulphide (H_2S). In order to set the carbon disulphide free from the impurities it is well shaken up with mercury; but this *modus operandi* is a tiresome one and the product is not well cleaned.

The following method was found to be the best for cleaning impure carbon disulphide:—The impure product is well mixed in a high glass with some lead nitrate (Pb_2NO_3) and with a small quantity of metallic lead; when the salt turns dark, the liquid is poured into another glass with a fresh quantity of the lead salt, and so on until the salt remains nearly white while mixed with the liquor. The carbon disulphide is then placed in a retort, and distilled over into a well cooled receiver.

During these experiments a peculiar phenomenon was observed; when the salt was mixed in the crystalline form with carbon disulphide during 10–15 minutes, the crystals were covered with a silver-like precipitate. If these crystals placed on filtering paper are examined

* This reaction has, I need hardly say, nothing to do with the action of permanganate on nitrous acid.

through a microscope they have a very beautiful appearance. These experiments are not finished, and if the results prove of interest they will be communicated.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.*

(Continued from p. 153.)

THE temperature of the flame does not, however, depend exclusively on the heat of combustion. The density of the burning body and the specific heat of the products of combustion must also be taken into account. Hence it comes that the temperature of the hydrogen flame in pure oxygen is about 6800° , in air about 2600° ; the temperature of the flame of carbonic oxide in oxygen amounts to 7000° , in air about 3000° ; † further according to calculation 1 vol. of hydrogen = 1 grm. is capable of fusing 205 grms. of platinum, whilst the same volume of carbonic oxide can fuse 238 grms. of platinum (melting-point 2000° .) In practice, however, even under the most favourable conditions, as Deville and Debray determined in their researches on platinum, about half the heat is lost by conduction to the furnace and other surrounding matter, and the above authorities with 120 litres of hydrogen and 60 of oxygen succeeded in fusing only 1 kilo. of platinum instead of double the amount as calculated. Platinum can also be smelted and refined under similar circumstances with coal-gas. But for the more infusible metals of the platinum group, iridium, ruthenium, and their alloys, the hydrogen flame must be retained, which, if costlier than coal-gas, is cheaper than carbonic oxide.

In the use of gases as fuel the metal itself can be brought in contact with the flame, which is impracticable in case of carbon, and thus the great loss of heat is avoided which ensues when the crucible is heated from without. Their application renders it also possible to inspect the condition of the metal at any moment. In the metallurgy of the common metals these two advantages do not come into consideration. Carbon, moreover, is not only the cheapest but the most productive fuel, ‡ and the application of hydrogen as a source of heat seems therefore limited to autogenous soldering and to the fusion of the most refractory platinum metals.

The property of platinum-black to ignite hydrogen, of which Döbereiner made a well-known and widely utilised application in his hydrogen lamp in 1823, has lost its practical importance owing to the discovery of friction matches.

The more intense and permanent was the interest which hydrogen created as a source of light.

As the luminous power depends on the temperature at which a solid ignited body is maintained the suggestion was near at hand to produce an intense light by means of this gas, in which an incombustible body was heated to whiteness. To this end the Scotch military engineer Drummond used in 1826 cylinders of caustic lime heated in the oxyhydrogen flame. The Drummond light has been widely employed, not merely in geodetic measurements and in lighthouses, which the inventor had principally in view, but also for projections of microscopic objects and photographic images on glass, or drawings upon gelatine for demonstration in lecture-halls, || for dissolving views,

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Debray, "Sur la Production des Températures Elevées et sur la Fusion de la Platine." Leçons de Chimie en 1861, 65; Paris, 1862.

‡ The calculated temperature of the flame of carbon in oxygen is $10,000^{\circ}$, from which has to be deducted the unknown amount of heat which at this temperature is lost by dissociation. See Debray, *opus citat.*

|| This Report, p. 14; also H. Vogel, *Ber. d. Chem. Gesell.*, iii., 901.

and chromatropes. In the American civil war it was used in sieges to light up forts.* The English war department has tried it in barracks, in large halls and courts, in which† it is said to have proved cheaper than coal-gas, whilst the smallest characters could be read at a distance of 90 metres from the source of light.

(To be continued.)

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.‡

By GEORGE E. DAVIS, F.C.S.

ALTHOUGH the manufacture of soda-ash is spread throughout the whole length and breadth of Lancashire, the manufacture of the hydrate commonly called caustic soda is concentrated in Widnes and St. Helens.

Books give us but little information upon the subject of white caustic soda, cream caustic is mentioned in a few; but even that was written upon when the manufacture was in its infancy; and though but little change has been made in this branch of late, still the chemistry of the process has received much development.

Before describing the process of manufacture in its chemical and physical details, I would wish to lay before you a short history of the manufacture, and if I am thought to be digressing from my path in first describing the history of cream or red-liquor caustic, it must be remembered that this was the forerunner of white, and that the development of the one led to the manufacture of the other.

Le Blanc's process as originally devised was for the production of carbonate of soda only, and was intended as a substitute for kelp or Spanish barilla; and when the artificial soda was introduced as vat-liquors simply evaporated to dryness and containing a large quantity of caustic soda, the presence of this latter compound was found seriously to interfere with the application of this variety in many processes where Spanish barilla or kelp was formerly used.

In the manufacture of soap, which was then a large trade, the presence of caustic soda in the commercial soda-ash was rather an advantage, as the soap lyes were produced by the soap maker himself by boiling a weak solution of soda-ash with lime, but for many purposes the caustic soda in the ash had to be carbonated, and the idea occurred to Gossage in 1853, or perhaps before that time, of separating the carbonate and other foreign salts by concentration and other means now well known, and leaving the hydrate in solution as red-liquors, from which solid caustic soda could be obtained by concentrating sufficiently.

Soon after this solid caustic soda entered the market, and became as staple an article of commerce as soda-ash had already become. The first attempts were what we should now call bad or discoloured caustic, and various means were patented from time to time to free the liquors from sulphides of both iron and sodium, and so produce caustic soda of good quality. In 1855 Stott patented a process for freeing vat liquors from sulphides by means of the oxides of iron, manganese, or zinc, and exactly the same thing was patented in 1857 by Gossage, and in subsequent years by many others. In 1857 we have a method patented by Bakewell for packing caustic soda in sheet iron drums, the article before that time being chiefly solidified by pouring it upon iron plates, breaking up and packing in casks or barrels. In some works after packing thus, the cask was filled up with the fluid caustic from the pots.

About this time the demand for caustic soda must have been greater than the supply, for we find manufacturers

* Wagner, "Lehrbuch der Technologie." 9th edit., ii., p. 377.

† *Journal of Gas-lighting*, 1869.

‡ From the *Journal of the Society for the Promotion of Scientific Industry*.

turning their attention to the causticising of liquors by means of lime. Still this was only to supply the increasing demand for what we should now call "cream caustic," as no other kind but one was known then, and in 1858 four Thomas's obtained a patent for causticising with lime and oxidising the sulphides with air in one operation.

The increased dilution of the liquors then began to tell upon the cost of production, and in 1859 Dale obtained a patent for the process of concentrating the weak caustic liquors in steam boilers, and using the steam for various purposes.

Many were the patents obtained between 1853—1860 in connection with the manufacture of caustic soda, but they are of little interest, and no real improvement was made until some time after November, 1860, when Ralston patented the following improvements:—"If it is desired to produce a hydrate of great strength, evaporating and separating the foreign salts, but in place of keeping the heat low as hitherto, the evaporation is continued and the heat raised until the iron separates as oxide of iron, and until the oxide is precipitated to the bottom of the vessel, the clear alkali is then separated from the iron. The alkali will then be free from iron and of great strength."

It was also added that if the alkali was not required of so high a strength salt was to be added while in dry fusion, or in preference the foreign salts were not to be separated in the first instance.

This may be considered as the commencement of white caustic; that it was ever made before this is extremely improbable, from the fact that the early manufacturers used very thin pots for concentrating and finishing, and a manufacturer would scarcely have ventured to raise four or five and even six tons of caustic soda in them to the state of igneous fusion, and have kept the pot at that temperature during the time necessary for the setting of the oxide of iron. Again, it was known to most of the caustic soda manufacturers of that day, that the best colour was produced when the samples contained most water and a minimum of neutral salts; so they dared not concentrate to much above 60 per cent of alkali for fear of deteriorating their colour, and so producing an unsaleable article.

Even for some time after Ralston's patent fused or white caustic soda was very slightly known; the only publication concerning it of which I am aware was written by Dr. Pauli, and appeared in the *CHEMICAL NEWS* for 1862. Norman Tate mentioned this paper in an article to the *Pharmaceutical Journal*, September, 1862, which article was founded on a very interesting paper on caustic soda, read by Mr. Tate before the members of the Liverpool Chemists' Association, May 15, 1862; but white or fused caustic was but barely alluded to in his paper. Dr. Pauli, however, clearly indicated the process in June, which is followed to the present day.

In the early days of the white caustic manufacture, it was produced in some places by dissolving and causticising a soda-ash, and, in others, from diluted vat liquors; but in Richardson and Watts's "Technology" Pauli states the method used at the Union Alkali Works, St. Helens, where commercial caustic soda (presumably that obtained from the red liquors of Gossage's process) was "heated to fusion, and kept at that temperature through the night, when, besides the oxide of iron, the alumina is separated as a crystalline silicate."

This separation of alumina as a silicate I have never found to be the case with caustic from vat liquors causticised with lime, but from theoretical considerations there is a possibility of its happening with caustic from fused red liquors, which often contains a large proportion of silicate of soda.

About this time Messrs. Gaskell, Deacon, and Co. patented a process for producing crystals of caustic soda, of which an analysis is given in Richardson and Watts's "Technology;" but these crystals never became a commercial success. At the International Exhibition of 1862, there were several samples of caustic soda exhibited, some of which were undoubtedly cream, others were fused, and

some among this latter class were easily detected by possessing the greenish tinge due to over nitreing.

The Jarrow Chemical Company, South Shields, exhibited caustic soda from the Newcastle district, while Lancashire was represented by Messrs. Gaskell, Deacon, and Co., Messrs. Hutchinson and Earle, Messrs. Roberts, Dale, and Co., and the Messrs. Muspratt of Liverpool, Flint, and Widnes. One exhibit came from the works of the Sambre and Meuse Joint Stock Mining Company. From Austria there were several exhibits of caustic soda; the sample exhibited by Messrs. Miller and Hochstadter being specially mentioned by the jurors as being very white.

Since this time the manufacture has become wonderfully extended; one firm in Widnes, when in full work, turning out equivalent to 250 tons of 60 per cent caustic per week, and several others from 60 to 80 tons each weekly. In St. Helens there are four or five works, with a weekly turn out of from 60 to 80 tons of 60 per cent each, and all this by causticising vat liquors with lime, which contrasts very unfavourably with the statement in Wagner's "Technology," that "the use of lime for the transformation of sodium carbonate into caustic soda has been abandoned long since" (1873).

Such is the history of white caustic soda. I will now turn to the present mode of manufacture in its most scientific form, starting with the black-ash process, and will divide the subject into five divisions, taking them as separate portions of one great whole.

1. Black ash-making; 2. Lixiviating the black-ash; 3. Causticising; 4. Concentrating; and 5. Finishing.

1.—The Black-ash Process.

Black-ash, as is well known to practical men, is made by fluxing together a mixture of salt cake, carbonate of lime in various forms, and slack. There are two sizes of balls generally worked in the trade and designated by the amount of salt cake the mixing contains. The first are of small size and are called twenty stone balls because they contain $2\frac{1}{2}$ cwts. of salt cake; the second are of larger size, and are called twenty-four stone balls because they contain in the mixing 3 cwts. of salt cake.

In balls where the carbonate of lime is introduced as limestone the weight of this latter per ball is generally that of the salt cake employed; in some cases it is more, especially when used in the manufacture of caustic soda and in this case the proportion of slack is also more than when a soda-ash is made.

For caustic soda when twenty stone balls are worked the following is a mixing from actual practice:—

| | |
|-------------------|-----------|
| Salt cake | 2.5 cwts. |
| Limestone | 2.75 " |
| Slack | 1.5 " |

The slack used as it is for its carbon may vary considerably in its weight per ball. This will of course depend upon the amount of moisture present as well as upon the amount of ash left on ignition.

Another firm working twenty-four stone balls make up their mixing as follows:—

| | |
|-------------------|-----------------|
| Salt cake | 3 cwts. |
| Limestone | 3 " |
| Slack | 1.625 to 1.75 " |

The number of balls drawn in different works varies considerably; some draw twenty-five small balls in the twenty-four hours from each furnace, whilst it is said that some draw from thirty to thirty-three; but when twenty-four stone balls are worked the general rule is twelve balls on the day shift and thirteen on the night turn. This is considered as good work, which should be performed regularly, producing a good and regular black-ash, lixiviating easily and containing a minimum of sulphate and sulphide.

Where chalk is used as the source of carbonate of lime, an extra quantity is required to make up for the water present, but as chalk is not used in the Widnes, St.

Helens, or in the Manchester districts, the two former being the great seats of the caustic soda manufactures it is not necessary to enter into details. But where white caustic soda is made, the black-ash ball is compounded of several materials not included in the foregoing mixings. The lime mud from the causticising operation is made to replace its equivalent of limestone, and the salts which are separated at various stages of the concentration of the causticised liquors are also added in quantity varying with the rate of production.

In one works, where twenty stone balls were drawn, and making nothing but white caustic soda, the black-ash was made from the following mixing:—

| | |
|----------------------|-----------|
| Salt cake | 2.5 cwts. |
| Lime mud | 2.5 " |
| Limestone | 1.5 " |
| Slack | 1.5 " |
| Fished salts | 14 lbs. |

It was a good, regular black-ash, the analysis of which may be seen further in this section. Good balls have also been made from all lime mud after the following mixing:—

| | |
|-------------------|-----------|
| Salt cake | 2.5 cwts. |
| Lime mud | 5.0 " |
| Slack | 1.5 " |

Good balls have also been made from all salts and limestone, but this is a most expensive proceeding, as such a tremendous excess of limestone over the sulphate contained in the mixing is required to keep the ball stiff. The following is the mixing for all salts, but should not be employed, unless, first, either the stock of salt cake is worked up, or, secondly, it has become necessary to work up a large stock of salts:—

| | |
|----------------------|---------|
| Fished salts | 2 cwts. |
| Limestone | 3 " |
| Slack | 1.5 " |

The fished salts would scarcely contain more than 0.7 cwt. of real salt cake; therefore, it may be readily seen what an expensive process this is.

These are all mixings for hand furnaces. Perhaps it will be thought I should have mentioned revolvers, but, as treating the subject properly would take too much time, and swell this paper into gigantic proportions, I leave the subject untouched.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

ON TEA.

By G. W. WIGNER.

THERE are so many varieties of tea imported into this country that, in order to ascertain their distinguishing chemical characteristics, it is necessary to analyse a large number of samples.

I have, therefore, determined to supplement a paper I published some months ago by the results of a large number of analyses made since.

The samples I have examined comprise, as well as the ordinary teas of commerce, certain rarer kinds, the characteristics of which are less generally known, and which will, perhaps, possess some interest for my brother Analysts.

The *moisture* of teas is generally considered a matter of little moment, and consequently is seldom determined.

It would appear, however, that it bears a certain relation to the individual kind of tea, and that its limits of variation are wider than is generally supposed; as I have found the proportion as low as 4.20 per cent, and as high as 10.80 per cent.

Tea is hygroscopic, and, when exposed to the air, after having been dried at a temperature of 212° F., will gain weight with considerable rapidity.

The table (see next page) shows the results of some teas

so dried and then exposed to the atmosphere of my laboratory during parts of the months of February and March in this year.

It will be seen that the Hysons and Gunpowders, both of which are high-dried teas, contain the smallest amount of moisture—the two Hysons yielding, respectively, 5.68 per cent and 4.84 per cent, and the highest percentage yielded by a gunpowder being 6.55 per cent, and the lowest 4.94 per cent; while the Congous (which have already been dried at a lower temperature) give an average of 8.50 per cent. The average of the entire table is 7.67 per cent. The average weight of water re-absorbed after 11 days' exposure to the air is 6.93 per cent, deducting which from 7.67 shows that, taking the average, the samples regained by exposure to the air all their original weight of moisture, less 0.74 per cent.

The different classes of tea showed, however, strikingly different results. For instance, one sample of Congou, originally rather dry, gained moisture to the extent of 1.75 per cent *in excess of its original moisture*. Every other sample of Congou except one failed to reach its original weight, the average loss being about 1.7 per cent. Similarly, the Pekoes in every case but one show an ultimate loss to nearly the same extent. On the other hand, the high-dried teas, Hysons and Gunpowders, show an increase in every case, averaging more than 1 per cent.

The general tendency of this exposure to the air serves to bring the moisture of the whole to an average of about 7 per cent; but the limit of difference after exposure is very much narrower than before, the range of moisture before drying being 5.96 per cent, and after drying and exposure to air, 2.62 per cent. In my previous paper I gave the results of the partial analysis of the ash of twenty-four samples of genuine tea of ordinary character, and also of four samples of special growths of tea.

The list of ordinary teas may with advantage be increased, and for the information of those who may not be familiar with the *appearance* of the rarer teas, it is yet more important to record the chemical results of such samples.

I therefore subjoin a tabulated statement showing the results of the analysis of seventeen more samples of ordinary teas, and of eighteen samples of what I may term uncommon, or special teas.

The number attached to each remains constant to the respective sample in the other tables which I give.

The "special" teas were all taken from original packages, and had, therefore, undergone no manipulation in this country. They were mostly of high price, and, being only imported for the purpose of "mixing," would not by themselves yield a pleasant infusion.

These analyses have all been made on a uniform plan, viz., igniting 100 grains of the tea, boiling the ash in 5 ounces of water, and washing on the filter with cold water. The alkali is estimated by adding excess of normal acid and titrating back.

Ordinary Teas from Original Chest. (Partial Analysis of Ash.)

| No. | Description. | Total Ash. | Soluble in Water. | Soluble in Acid. | Silica. | Potash. |
|-----|--------------|------------|-------------------|------------------|---------|---------|
| | | Per cent. | Per cent. | Per cent. | | |
| 36 | Indian | 5.58 | 3.06 | 2.20 | 0.32 | 1.45 |
| 27 | " | 5.82 | 2.75 | 2.87 | 0.20 | 1.36 |
| 38 | Congou | 5.96 | 3.12 | 2.68 | 0.16 | 1.65 |
| 39 | " | 5.63 | 3.25 | 2.08 | 0.30 | 1.41 |
| 40 | " | 5.89 | 3.10 | 2.04 | 0.75 | 1.27 |
| 41 | " | 5.83 | 3.03 | 2.04 | 0.76 | 1.32 |
| 42 | " | 5.65 | 3.07 | 2.27 | 0.31 | 1.37 |
| 43 | " | 5.61 | 2.75 | 2.33 | 0.53 | 1.27 |
| 44 | " | 5.71 | 2.75 | 2.33 | 0.63 | 1.17 |
| 45 | " | 5.76 | 2.82 | 2.50 | 0.44 | 1.26 |
| 46 | " | 5.92 | 3.25 | 2.08 | 0.59 | 1.41 |
| 47 | " | 5.78 | 3.08 | 2.04 | 0.66 | 1.17 |
| 48 | " | 6.03 | 3.35 | 1.99 | 0.69 | 1.17 |
| 49 | Gunpowder | 5.75 | 3.10 | 2.34 | 0.31 | 1.32 |
| 50 | " | 5.64 | 3.11 | 2.14 | 0.39 | 1.36 |
| 51 | Hyson | 5.69 | 3.35 | 2.18 | 0.16 | 1.88 |
| 52 | Congou | 5.53 | 3.32 | 2.06 | 0.15 | 1.60 |
| | Average | 5.75 | 3.07 | 2.25 | 0.43 | 1.38 |
| | Maximum | 6.03 | 3.35 | 2.87 | 0.76 | 1.88 |
| | Minimum | 5.53 | 2.75 | 1.99 | 0.15 | 1.17 |

MOISTURE AND HYGROSCOPIC PROPERTIES OF TEA.

| No. | Description. | Weight of 100 Grs. dried at 212° F. | Water. | Weight after Exposure to the Air in Open Vessel for— | | | | Total Gain of Weight after Exposure to Air. |
|-----|-------------------------|---|--------|---|--------------|----------------|-----------------|--|
| | | | | Four Days. | Six Days. | Eight Days. | Eleven Days. | |
| 1. | Indian young Hyson.. | 94.32 | 5.68 | 97.57 | 99.80 | 100.54 | 100.88 | 6.56 |
| 2. | Moyune „ „ | 95.16 | 4.84 | 98.92 | 101.25 | 101.25 | 101.25 | 6.09 |
| 3. | Gunpowder .. „ | 95.06 | 4.94 | 100.68 | 101.01 | 101.17 | 101.10 | 6.04 |
| 4. | Moyune guupowder .. | 94.84 | 5.16 | 98.54 | 100.63 | 101.07 | 101.31 | 6.47 |
| 5. | „ „ | 94.30 | 5.70 | 98.22 | 100.35 | 100.50 | 100.50 | 6.20 |
| 6. | „ „ | 93.82 | 6.18 | 97.83 | 100.09 | 100.52 | 100.77 | 6.95 |
| 7. | „ „ | 93.45 | 6.55 | 97.42 | 99.67 | 100.44 | 100.43 | 6.98 |
| 8. | Medium Oolong (1874) | 93.70 | 6.30 | 99.85 | 100.02 | 100.26 | 100.22 | 6.52 |
| 9. | Oolong .. „ | 93.23 | 6.77 | 97.88 | 99.99 | 100.45 | 100.89 | 7.66 |
| 10. | Manuna (fine) .. „ | 92.91 | 7.09 | 98.32 | 98.61 | 98.88 | 98.90 | 5.99 |
| 11. | Broken Indian .. „ | 92.70 | 7.30 | 97.43 | 99.87 | 100.41 | 100.24 | 7.54 |
| 12. | Fine Kaisow .. „ | 91.40 | 8.60 | 98.48 | 98.36 | 98.76 | 98.59 | 7.19 |
| 13. | Kaisow (1870) .. „ | 89.48 | 10.52 | 96.26 | 96.49 | 96.73 | 96.66 | 7.18 |
| 14. | „ „ | 89.20 | 10.80 | 96.79 | 96.82 | 96.89 | 96.67 | 7.47 |
| 15. | Orange Pekoe .. „ | 94.42 | 5.58 | 98.45 | 100.64 | 101.00 | 101.22 | 6.80 |
| 16. | Indian „ .. „ | 93.13 | 6.87 | 99.49 | 99.70 | 99.91 | 99.93 | 6.80 |
| 17. | Scented orange Pekoe .. | 92.21 | 7.79 | 98.12 | 98.25 | 98.39 | 98.32 | 6.11 |
| 18. | So Pekoe (1869) .. „ | 90.61 | 9.39 | 96.64 | 97.06 | 97.31 | 97.29 | 6.68 |
| 19. | Pekoe siftings .. „ | 90.55 | 9.45 | 96.81 | 96.86 | 96.92 | 96.80 | 6.25 |
| 20. | Consolidated .. „ | 91.89 | 8.11 | 96.58 | 98.65 | 98.95 | 99.14 | 7.25 |
| 21. | Indian Souchong .. „ | 91.84 | 8.16 | 98.14 | 98.35 | 98.58 | 98.46 | 6.62 |
| 22. | Caper .. „ | 93.20 | 6.80 | 98.30 | 98.00 | 98.60 | 99.00 | 5.80 |
| 23. | „ .. „ | 93.00 | 7.00 | 98.90 | 98.20 | 99.00 | 99.00 | 6.00 |
| 24. | „ .. „ | 92.00 | 8.00 | 98.60 | 98.20 | 98.30 | 98.90 | 6.90 |
| 25. | „ .. „ | 92.00 | 8.00 | 99.00 | 98.20 | 98.80 | 98.90 | 6.90 |
| 26. | „ (1872) .. „ | 91.48 | 8.52 | 98.26 | 98.47 | 98.63 | 98.47 | 6.99 |
| 27. | Indian Congou .. „ | 93.44 | 6.56 | 98.41 | 100.93 | 101.58 | 101.75 | 8.31 |
| 28. | Congou.. .. „ | 92.72 | 7.28 | 97.25 | 99.57 | 100.00 | 100.08 | 7.36 |
| 29. | „ .. „ | 91.94 | 8.06 | 96.41 | 99.39 | 99.54 | 99.68 | 7.74 |
| 30. | Moning Congou .. „ | 91.51 | 8.49 | 99.00 | 99.00 | 99.33 | 99.09 | 7.58 |
| 31. | New District .. „ | 91.36 | 8.64 | 96.71 | 99.62 | 99.78 | 99.78 | 8.42 |
| 32. | Moning .. „ | 90.92 | 9.08 | 98.76 | 97.84 | 98.08 | 97.97 | 7.05 |
| 33. | Congou.. .. „ | 90.83 | 9.17 | 98.56 | 98.32 | 98.40 | 98.21 | 7.38 |
| 34. | „ (1869) .. „ | 89.96 | 10.04 | 96.67 | 96.72 | 97.04 | 96.87 | 6.91 |
| 35. | „ .. „ | 89.67 | 10.33 | 96.65 | 96.80 | 96.85 | 96.62 | 6.95 |

Putting these results with those of the twenty-four samples previously published, we find—

| | Total Ash. | Soluble Aqua. | Soluble Acid. | Silica. | Potash. |
|------------|---------------|------------------|------------------|---------|---------|
| Average .. | 5.69 | 3.03 | 2.22 | 0.44 | 1.49 |
| Maximum .. | 6.03 | 3.35 | 2.87 | 0.78 | 1.88 |
| Minimum .. | 5.46 | 2.67 | 1.97 | 0.15 | 1.17 |

These results from forty-one different pure samples may be certainly assumed to represent fairly the ordinary teas of commerce as imported.

I pass now to the special samples, which vary in price but are generally high, Nos. 1, 2, 4, 6, 7, and 53 ranging between 3s. and 3s. 6d. per lb. in bond.

Special Teas from Original Chests.

| No. | Description. | Total Ash. | Soluble in Water. | Soluble in Acid. | Silica. | Potash. |
|---------|----------------------|---------------|-------------------------|------------------------|---------|---------|
| | | p. ct. | p. ct. | p. ct. | p. ct. | p. ct. |
| 1 | Indian young Hyson | 5.32 | 3.27 | 1.94 | 0.11 | 1.69 |
| 2 | Moyune „ | 5.75 | 3.71 | 1.74 | 0.29 | 1.83 |
| 4 | Moyune Gunpowder | 5.83 | 3.67 | 1.83 | 0.33 | 1.51 |
| 5 | „ | 5.61 | 3.22 | 2.11 | 0.28 | 1.56 |
| 6 | „ | 5.63 | 3.44 | 1.81 | 0.38 | 1.51 |
| 7 | „ | 5.50 | 3.51 | 1.80 | 0.19 | 1.51 |
| 8 | Medium Oolong (74) | 6.34 | 3.59 | 2.23 | 0.51 | — |
| 9 | Oolong | 5.27 | 3.15 | 1.83 | 0.29 | 1.51 |
| 10 | Naununa (fine) | 6.80 | 3.80 | 2.60 | 0.40 | 1.32 |
| 11 | Broken Indian | 5.17 | 2.92 | 2.21 | 0.04 | 1.96 |
| 12 | Fine Kaisow (1874) | 6.46 | 3.43 | 2.46 | 0.57 | 1.41 |
| 17 | Scented orange Pekoe | 6.84 | 3.30 | 2.68 | 0.86 | 1.26 |
| 21 | Indian Souchong | 5.60 | 3.49 | 1.86 | 0.25 | — |
| 53 | Oolong | 5.49 | 3.88 | 1.33 | 0.28 | 1.46 |
| 54 | „ | 5.54 | 3.78 | 1.63 | 0.13 | 1.51 |
| 55 | Assam | 5.55 | 3.36 | 1.97 | 0.21 | 1.60 |
| 56 | Java | 5.54 | 3.26 | 2.24 | 0.04 | 1.36 |
| 57 | Moyune siftings | 6.16 | 3.20 | 2.38 | 0.58 | 1.74 |
| Average | | 5.80 | 3.44 | 2.04 | 0.32 | 1.39 |
| Maximum | | 6.80 | 3.88 | 2.68 | 0.86 | 1.96 |
| Minimum | | 5.17 | 2.92 | 1.33 | 0.04 | 1.26 |

I have kept the capers in a separate list because, although this class of tea is the one most frequently adulterated, yet it is perfectly possible to procure pure samples. The following table fairly shows the character of pure caper teas:—

Genuine Capers.

| No. | Description. | Total Ash. | Ash Soluble in Water. | Ash Soluble in Acid. | Silica. | Potash. |
|---------|--------------|---------------|-----------------------------|----------------------------|---------|---------|
| 23 | Caper | 5.90 | 3.16 | 1.86 | 0.83 | 1.42 |
| 74 | „ | 6.94 | 2.66 | 2.61 | 1.67 | 1.50 |
| 75 | „ | 7.02 | 3.66 | 1.96 | 1.40 | 1.32 |
| 76 | „ | 5.75 | 3.00 | 1.88 | 0.87 | 1.32 |
| 77 | „ | 5.75 | 2.64 | 2.41 | 0.70 | 1.41 |
| 78 | „ | 6.22 | 3.10 | 2.20 | 0.92 | — |
| 79 | „ | 6.23 | 3.10 | 2.37 | 0.76 | 1.53 |
| 80 | „ | 6.33 | 3.44 | 2.10 | 0.79 | 1.32 |
| 81 | „ | 6.11 | 2.85 | 2.36 | 0.90 | 1.08 |
| Average | | 6.25 | 3.07 | 2.19 | 0.99 | 1.35 |
| Maximum | | 7.02 | 3.66 | 2.61 | 1.57 | 1.53 |
| Minimum | | 5.75 | 2.64 | 1.86 | 0.70 | 1.08 |

Putting these results in the same average with the other special teas, the figures are—

Average of 25 Special Teas.

| | | | | | |
|------------|------|------|------|------|------|
| Average .. | 5.95 | 3.33 | 2.09 | 0.53 | 1.38 |
| Maximum .. | 7.02 | 3.88 | 2.68 | 1.67 | 1.96 |
| Minimum .. | 5.17 | 2.64 | 1.33 | 0.04 | 1.08 |

These results are sufficient in number to give not merely a fair average, but a very good basis for assuming what are the maximum deviations likely to be met with in genuine tea.

It is possible to find samples of dried tea-leaves which would show slightly greater deviations from the average than even the special teas enumerated here, but such samples are not commercially met with. For instance, I believe from certain old samples which I have examined,

that some teas which have been in bond for many years, and were probably of very inferior quality originally, may occasionally be found which deviate a few hundredths, more or less, from these figures, but such tea is practically unsaleable, and may be left out of consideration. And, on the other hand, it may be possible that some kinds of tea, such as Russian overland, may show even more soluble ash. Still, as my samples would in many cases be retailed as high as 6s. per lb., I think we may fairly exclude all higher priced teas.

(To be continued)

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Indeed I do not “object” to the title of the proposed Mineralogical Society. Its “breadth,” as Mr. Collins puts it, is ample enough. I only think the title rather too long for ordinary use. But, having just risen from the compilation of a Dictionary of Mineral Synonyma (some 10,000 or 12,000 British and Foreign, which I propose as my first contribution to the new Society), I may be excused, if, for a time, I have “nomenclature on the brain” rather, and prefer *short* names to long names whenever they are appropriate. Many ordinary people prefer “taking a ’bus,” to “taking an omnibus.” Many eminent geologists speak in a homely way of “beds” and “basins.” And there are some eminent chemists who still talk familiarly of “potash” and “soda.” Why should they not? Most people like to shorten the journey to desirable places, and why may they not do ditto to scientific ideas?

But everybody knows that it is quite possible to carry even *expressive* words to an uncomfortable length. I append examples of such anti-telegraphic verbal elongation. I do not, however, put them as trifles to smile at. Although a matter of small importance, allow me to say that I, for one, am quite content to take Mr. Collins’s title as it stands.

Anyhow, let there be a Mineralogical Society in *fact*.

True, the notion is in its early day yet; but already a goodly array of hard-working mineralogists have given in their adhesion to the movement, who will be joined by a good many more at noon-day I fancy. This looks like the advent of business. A Mineralogical Society is certain to be formed, and mainly of earnest workers. That they *will work* there is not the slightest shadow of a doubt. They mean to do *meritorious* work too I expect, and when they shall have done so, as a consequence, the Society will stand a chance of being known as “The Mineralogical Society” *par excellence*.—I am, &c.,

T. A. READWIN.

Liverpool, September 27, 1875.

P.S.—“Nickelthoneisenzinksilicat.”

“Sehr verworren schiefrieger thonglimmerschiefer.”

“Hydrochloride of ethenylbromophenylenediamite.”

“The anti-leaving-little-fatherless-responsibilities-at-other-people’s-door-Society.”

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l’Academie des Sciences. No. 9, August 30, 1875.

Tenth Notice on the Electro-conductivity of Bodies Sparingly Conductive.—M. Th. du Moncel.—The strength of the current traversing certain minerals

increases with the time that the circuit remains closed, whilst in other species it diminishes. This is especially the case with soft and porous stones. Minerals both hard and soft, with certain exceptions, among which may be ranked such as have undergone the effects of fire and of crystallisation, absorb more or less moisture from the air, and become conductive under its influence. Calorific effects always result in decreasing or destroying the conductivity of minerals.

Germination of the “Chevallier” Barley.—M. A. Leclerc.—A controversial paper, rather physiological than chemical, in reply to an essay by M. Deherain. See *Comptes Rendus*, lxxxii., p. 198.

Formation of Aniline-Black by the Electrolysis of its Salts.—M. J. J. Coquillion.—It is known that aniline-black is obtained by dissolving a salt of aniline in water and adding chlorate of potash and a metallic salt. Sulphide of copper and sulphate of iron are particularly recommended, and according to the majority of authors the presence of a metallic substance is indispensable for the production of aniline-black. The author proposes to show that aniline-black may be obtained without the intervention of any metal, simply by the action of nascent oxygen upon certain salts of aniline. For this purpose he submitted these salts to electrolysis and obtained the following results:—If a concentrated solution of sulphate of aniline is submitted to the action of two Bunsen elements with platinum electrodes, the positive pole is soon covered with a violet-blue pellicle, greenish in certain parts, as was observed by Litheby (? Letheby). But if the experiment is prolonged for twelve to twenty-four hours there is found fixed to the positive pole a black adhesive substance. On treating this substance with ether and alcohol and drying it in the stove there remains a black amorphous matter with greenish reflections, insoluble in most solvents. If this body is treated with sulphuric acid and spread out in a thin layer it takes a greenish colour, but in contact with alkalis it returns to a velvet-black. Nascent hydrogen has no effect upon it. To be sure that the production of this black was due to the nascent oxygen and not to the platinum serving as an electrode, the author used electrodes made out of gas-coke and obtained identical results,—a black mass being fixed to the positive pole, whilst bubbles of hydrogen were found around the negative pole. Nitrate of aniline gave also a black deposit, which in contact with alkalis took a velvety appearance, but was decomposed by sulphuric acid, with a maroon-brown colouration. Hydrochlorate of aniline gave a clotty black product at the positive pole, but in this case the results are probably complicated by nascent chlorine. Acetate gave a black clammy substance at the positive pole, but with the tartrate of aniline there was no result, not even the slightest colouration. Hence it appears that aniline black may be obtained without the intervention of any metal, and that the salts of aniline behave in different manners in presence of nascent oxygen.

No. 10, September 6, 1875.

Study of the Cold Bands of Obscure Spectra.—MM. Desains and Aymonet.—If we disperse, by means of a prism of rock salt, a slender pencil of rays coming from a Drummond lamp, and study the distribution of heat in the spectrum thus obtained, we do not detect cold bands similar to those of the solar spectrum. They may, however, be developed. For this purpose the rays are forced to traverse before their incidence upon the prism suitably chosen absorbents. This fact has been established by one of the authors some years ago. In their more recent experiments they have made use of the lamp of Bourbouze and Wiesnegg as superior to that of Drummond. With a spectrum of rock salt of 60°, the rays having traversed a centimetre of water and the lenses of the apparatus being of rock salt, they discovered in the obscure part of the spectrum four cold bands, the respective distances of which from the red were 19·8', 30·6', 42', 52'.

Eleventh Note on the Electro-conductibility of Moderate Conductors.—Th. du Moncel.—The first conclusion which the author draws from his experiments is that minerals, like the major part of moderately conductive bodies capable of being affected by the air, possess two sorts of conductivity; the one electro-tonic, relating to the matter itself of which the bodies are composed, and an electrolytic conductivity relating to the moist layer which lines the sides of the porous interstices. We may therefore conclude that the secondary effects which are the consequence of these two kinds of conductivity must meet simultaneously in minerals, and as these have a very different electrostatic capacity, and as their power of absorbing atmospheric moisture is very variable according to their molecular texture and their nature, it results that in some of them the electro-tonic conductivity predominates, and in others the electrolytic.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 1, September 2, 1875.

This issue contains no original chemical matter save the description of a new burette invented by M. Maumène. This paper should have been accompanied by an illustration, which the editor states has been mislaid.

No. 2, September 9, 1875.

This issue contains no chemical matter.

M. Reimann's Farber Zeitung,
No. 33, 1875.

The Stettin Poisoning Case.—It is suggested that the poison here, if any, may be not the dye of the leather lining, but the mercurous nitrate employed in getting up the hare's hair, of which the hat was made.

Poppy-red for Artificial Flowers.—Thin cotton tissues are brushed over with a mixture of corallin-lake ground up with water and thickened with gum, 5 grms. of calcined magnesia per litre being added before use.

Production of Cochineal in the Canary Islands.—This crop is no longer remunerative, prices having fallen from 11 to 12 francs per Spanish pound (460 grms.) in 1848 to 2½ francs at the present date. Many planters are rooting out the nopals, as there is little prospect of the trade again becoming remunerative. The total exports from the Canaries in 1873-74 were 2,340,348 kilos., of which 1,452,030 kilos. were sent to England.

There are receipts for a black on wool capable of resisting scarlet dye; a slate grey for the same material; a brown for silks, and a mill-fast black for cotton.

Moniteur Scientifique, du Dr. Quesneville,
September, 1875.

Review of the Methods of Analysing Commercial Products.—M. A. G. Pouchet.—The author treats first of the analysis of sulphur ores, in which he states that errors of 1½ to 4 per cent are often made if the nitric acid employed in oxidising the sulphur is not driven off by the subsequent application of an excess of hydrochloric acid. If this precaution is omitted, the sulphate of baryta thrown down in presence of free nitric acid is somewhat soluble, and if abundantly washed, the result is too low. If, on the other hand, the washing is but slight, a quantity of nitrate of baryta may remain mechanically mixed with the sulphate, and the result is too high. The author then describes in succession processes for the assay of nitrate of soda, sulphate of soda—his processes for which call for no remark—common salt, hydrochloric acid, chloride of lime, and chlorate of potash. For the last-mentioned he takes 10 grms. of the sample, dissolves in 100 c.c. of water, and adds 250 c.c. of a saturated solution of sulphurous acid. It is heated at first gently, and then up to a boil to expel the excess of sulphurous acid, and when all odour of this gas has disappeared it is allowed to cool and made up to 500 c.c. with distilled water.

In 10 c.c. of this solution the chlorine is determined in the ordinary way with normal nitrate of silver. One part of chloride of sodium = 100 c.c. of the normal silver solution corresponds to 2.1 of chlorate of potash. For the assay of clays for alum making he proceeds as follows:—A mean sample of 50 grms. is taken and placed in a tared platinum or porcelain capsule. It is submitted to a moderate calcination. When it has attained a dull redness, the capsule is withdrawn, let cool, and weighed. The loss indicates the proportion of moisture and of volatile matters (combined water and organic matter). Upon the calcined clay are then poured 100 grms. of sulphuric acid at 60° B., the whole is well mixed with a glass rod, and heated till it becomes solid. It is then lixiviated with boiling water, and the alumina is determined in the ordinary manner in a known part of the solution. The author next treats of the salts from the mother-liquors of brine-pits, sulphate of potash, and ammoniacal salts.

MISCELLANEOUS.

Index to Mineralogy, &c.—An Index to Mineralogy, by Mr. T. A. Readwin, is ready for publication. The contents are:—

1. Table of the elementary substances (elements), with their chemical symbols, alphabetically arranged.

2. Table of mineral species and varieties (2816), alphabetically arranged, with concise references to their chemical composition, and place (when) in the Mineral Collection at the British Museum, and copious explanatory appendix.

3. Table of the simple minerals which frequently of themselves form rock-masses, or which enter largely and conspicuously into the composition of mineral aggregates (known commonly as *Rocks*), crystallographically arranged, with chemical analyses and formulæ.

4. Table of the elements in the order of their discovery, explanatory of their properties, history, sources, &c.

5. Table showing the known associations of the elements in mineral species.

6. Dictionary of mineral synonyma, British and Foreign (about 10,000).

An Index to Geology, by the same author, is also ready. Its contents are:—

7. Table of the simple minerals, which enter largely into the composition of rocks, chemically arranged.

8. Table of mineral aggregates or rocks, showing their composition, &c., alphabetically arranged.

9. Table of rocks, classified as to their modes of occurrence, sedimentary and otherwise.

10. Table of the systems, formations, and typical groups of strata, showing their characteristic rocks, minerals, and fossils.

11. Table of the British rocks, showing their estimated thickness, chief localities, commercial uses, &c.

12. Dictionary of rock synonyma, British and Foreign (about 3000).

13. Table showing the proximate mineral composition of plants and animals, alphabetical.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 828.

THE NATURE OF MUREXAN.

By JAMES REOCH, M.A., M.B.

IN my last paper on "Murexide," in the CHEMICAL NEWS, vol. xxx., page 265, I defended Liebig's view of its amide nature; his ideas as to the non-acid character of murexan seem, on the whole, to be equally well founded. When murexide is dissolved in KHO or NaHO, and boiled till the purple colour changes to yellow, a precipitate is always easily obtained by adding an excess of acid, while if the murexide be boiled with acid, a precipitate may be obtained on cooling, if the solutions be concentrated, but if not, no precipitate is obtainable merely by adding an alkali. Liebig, followed by Gmelin and others, seems not to have distinguished these two cases, but I have already shown that the precipitate obtained by adding acids is essentially alloxantin, while that got by adding acid to an alkaline solution is very different, and to it properly belongs the name of murexan. Now when murexide is boiled with an alkali, a quantity of NH_3 is given off, and the fluid is gradually decolourised; if an acid be now added, a yellow crystalline precipitate is obtained, HCl , H_2SO_4 . Acetic or malic acid may be used, but acet. fort. is for most purposes preferable to the mineral acids in dealing with easily decomposable organic principles. The crystals obtained by this acid are very peculiar, and much more complicated than the majority of the uric acid series, being like a square sheet of yellow paper with the corners rounded off, and two opposite corners curled up facing one another; all the other acids give some crystals similar to these, but they are generally more elongated, and sometimes arranged in rosettes. The formula for murexan has been very variously given.

Liebig gave C 33.3 per cent, H 3.7, and N 25.7. In three analyses for the C, I obtained 33.4, 34.4, and 32.2, the average being 33.3 per cent. This agrees with Liebig's analysis, but the amount of H and N differ widely. I found—

| | |
|--------|--------|
| H 4.60 | N 28.9 |
| 4.20 | 27.9 |
| 4.39 | 28.1 |
| 4.31 | 27.2 |
| 4.80 | |
| 4.80 | |

The average of these results gives 4.5 for the H and 28 for the N. The difference might be explained if Liebig adopted one of the two methods given for purifying murexan, by dissolving it in strong H_2SO_4 and precipitating by H_2O . In this case there is a tendency to the abstraction of NH_3 by the H_2SO_4 , and substitution of more oxygen by exposing the murexan twice in the water-bath; it is thus rendered more, instead of less, impure. Whether or not this will fully explain the low N determination of Liebig, at any rate these analyses of the N agree better with those of Kodweiss, Beilstein, and others. The whole analysis agrees with the formula $\text{C}_4\text{H}_6\text{N}_3\text{O}_3$ —

| | Calculated. | Experiment. |
|-------------------|-------------|-------------|
| $\text{C}_4 = 48$ | $= 33.30$ | 33.3 |
| $\text{H}_6 = 6$ | $= 4.16$ | 4.5 |
| $\text{N}_3 = 42$ | $= 29.16$ | 28.0 |
| $\text{O}_3 = 48$ | $= 33.30$ | 34.2 |
| 144 | 100.00 | 100.0 |

This formula appears also to explain the reactions of murexan, which is closely allied, though not identical, with uramil. Some chemists have maintained their

absolute identity, but the crystalline form is entirely different, and the colour is also different, uramil being chiefly white and murexan yellow. Nor is uramil precipitated from an alkaline solution by an acid. The formula of uramil, also, as given by Liebig, differs from that of murexan as given above by H_1 , though the agreement is sufficiently close to explain how murexide is derived from murexan in the same way as from uramil, for though there is no general agreement as to the formula of murexide, yet if supposed to be derived from uramil by simple oxidation and deprivation of H_2O , it would be derived from murexan in exactly the same way. That murexan has great affinity for O is easily proved by dissolving it in liq. potass., when it will absorb oxygen from many metallic oxides if boiled with them. These oxides vary greatly in the ease with which they surrender oxygen, but three may be singled out to typify the others, Ag_2O is one of the class most easily reduced, for a vast number of organic bodies reduce the Ag_2O precipitated from AgNO_3 by liq. potass. to the metallic state. Cu_2O is produced with greater difficulty from CuO ; few bodies can accomplish this deoxidation, but among them we have lactose and glucose. The most difficult deoxidation is the production of the blue oxide of molybdenum from molybdate of ammonium; glucose will not reduce it, though nascent H will do so easily. Now these three deoxidations are all easily accomplished by alloxantin, uramil, and murexan, showing that they all have an affinity for O exceeding that of glucose; but this seems to be more especially the case at boiling temperatures, or at least they readily pass into other bodies and surrender their O again, for if murexan be boiled with CuSO_4 and excess of alkali, though the suboxide appears copiously thrown down, yet the next day much less appears, it having probably been re-dissolved to form a copper salt of an organic acid derived from murexan. As to the intimate nature of murexan, we find that in some respects it resembles an acid, but scarcely so much as to justify the name of purpuric acid given by Prout. It is soluble in alkalis, and is easily precipitated therefrom in a crystalline condition by acids, and so far, therefore, resembles uric acid, but in other characters it more resembles an amide. Thus on boiling it with alkalis or with acids, NH_3 may in either case be detected by Nessler's test, and it is also very unstable in solution, for if its KHO solution be divided into two parts, and to one acetic acid added to-day and to the other half to-morrow, there will be a much smaller precipitate in the latter case, possibly from its absorbing oxygen from the air. While, therefore, it would be premature to discuss the general relations of the murexide compounds, it does not seem that any valid objections to the experiments of Liebig have been sustained.

ON A NEW REAGENT FOR GOLD.

By SERGIUS KERN, St. Petersburg.

STUDYING the action of sulphocyanates on some double salts of gold I have found a remarkable delicate test for gold; experiments prove that even less than 0.001 gramme of gold may be easily detected by using my reagent.

The gold of the sample under analysis is first separated from foreign metals and next converted by means of sodium chloride into sodio-gold chloride (NaAuCl_4); the solution is then concentrated by evaporation. In order to detect gold an aqueous solution of potassium sulphocyanide (KCyS) is used, containing for one part of the salt about 15 to 20 parts of water. About 6 grammes of this solution are poured into a test-tube and some drops of the concentrated solution obtained by treating the sample as described above are added. If gold is present a red-orange turbidity is immediately obtained which soon falls in the form of a precipitate; on

gently heating the contents of the test-tube the precipitate dissolves and the solution turns colourless.

The reagent is so delicate that one drop of a solution of sodio-gold chloride (1 gramme of the salt dissolved in 40 grammes of water) gives a very clear reaction.

This reaction showed the existence of very interesting double sulpho-cyanides of gold; researches in this direction are being continued, and when finished the results of the experiments will be communicated.

REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from page 160.)

Solution of the Manure and Separation of Silica.

IN the case of soluble phosphates, treatment with cold water, with (in some cases) subsequent washing with hot water, seems universal. Most chemists prefer to take a considerable quantity of the manure, and grind it with small successive quantities of cold water in a mortar. An aliquot part of the filtered solution is taken for analysis.

With but one or two exceptions hydrochloric acid is universally employed for effecting the solution of insoluble phosphates.†

In the great majority of cases they then recommend evaporation to complete dryness. Some operators omit this step, as a rule, but classify it among the precautions necessary when great accuracy is required. The effect of evaporation to dryness is considered to be two-fold. Silica is rendered insoluble, and fluorides are decomposed with volatilisation of hydrofluoric acid, or of fluoride of silicon. The residue is next treated with hydrochloric acid in the ordinary manner, and the insoluble silica‡ filtered off.

Oxalic Acid Method.

Of the chemists whose processes of analysing phosphates have been communicated to the Committee, a decided majority precipitate the phosphoric acid as the double phosphate of magnesium and ammonium, after previously separating the calcium as oxalate.

Although there is no great difference in the general outlines of the method followed, the most extraordinary variations occur in the details of the instructions, and in the precautions recommended to ensure accuracy.

By far the greater number of chemists precipitate the calcium as oxalate after neutralisation of the excess of acid. Some add citric acid previously to employing oxalate of ammonium. According to Mr. R. Warrington, this modification occasions a deficiency of lime, oxalate of calcium being soluble in citrate of ammonium. Those chemists who add citric acid before precipitating the calcium usually employ an acetate to get rid of free mineral acid. Of course the addition of citric acid then becomes a necessity when iron and aluminium are present, unless the precipitated phosphates of these metals are filtered off and estimated separately. This plan appears to have several advantages, and is recommended by some chemists of wide experience. By employing it the phosphates of iron and aluminium (by most chemists believed to have a very limited manurial value) are separately estimated, and

the subsequent addition of citric acid is rendered unnecessary, and the error introduced by its use avoided. If the phosphates of iron and aluminium are not previously separated, the general plan is to neutralise the solution with ammonia until a slight turbidity ensues, to clarify the liquid by the addition of a few drops of oxalic acid, to add a moderate excess of ammonium oxalate, to heat the liquid nearly to boiling, and to filter off the precipitated oxalate of calcium. Some chemists filter again after cooling. After careful washing of the precipitate, the filtrate is usually concentrated, a moderate quantity of citric acid added, and then excess of ammonia. A precipitate may here occur of silica, fluoride of calcium, or oxalate of calcium. The more careful analysts leave the solution for a time to make sure that the liquid remains clear, and filter from any precipitate.

Precipitation by Magnesia.

The clear solution is next precipitated by "magnesia mixture," which is universally admitted to be better made with chloride than sulphate of magnesium. It is also clearly proved, and generally recognised, that a large excess of the precipitant should be avoided, some chemists recommending a preliminary analysis of the sample with the view of adding the approximately theoretical quantity of solution. On the other hand, it has been proved that complete precipitation is very slow except in presence of a considerable excess of "magnesia mixture." Very great variation occurs with respect to the concentration and temperature of the solution at the time of precipitation. A few chemists recommend precipitation in a hot solution, but the majority direct precipitation in the cold. One or two recommend the use of a dilute solution, while others concentrate, if necessary, to a certain bulk; and some make a correction for the solubility of the double phosphate in the liquid.

The amount of free ammonia present during the precipitation varies from a moderate excess to one-fifth of its bulk of the strongest ammonia (0.880).

The time allowed for the precipitation varies from ten minutes (with vigorous stirring) to twenty-four hours, but most chemists are of opinion that six or eight hours are sufficient.

Very few chemists recommend that the double phosphate should be dissolved in acid and re-precipitated.

But few precautions appear to be taken in the ignition of the precipitate. The more careful analysts thoroughly dry the precipitate and remove it from the filter, igniting it first gently and then intensely.

Very different opinions are held as to the accuracy of the results obtained by precipitation with magnesia. In many cases the observers are merely able to say that the process gives fairly constant results on repetition. In other cases they state that very concordant results have been obtained when the same sample has also been analysed by some chemist of repute.

In some cases the observers consider that the process is liable to give results somewhat below the truth, owing to the slight solubility of the double phosphate in the mother-liquid, and the loss of phosphate in the oxalate of calcium precipitate. In other cases the process is said to give results in excess of the real amount, owing to the presence of other magnesium salts or of iron or aluminium, in the double phosphate precipitate.

A most elaborate series of experiments has been made by Mr. T. R. Ogilvie on the magnesia process and the variations to which it is liable.* His results have been to a great extent confirmed by the researches of Mr. E. M. Dixon. On the other hand, Professor Church writes:—"My confidence in this plan, when carried out successfully, giving time for any oxalate to fall after addition of citric acid and excess of ammonia, is not shaken by Ogilvie's results reported recently in the CHEMICAL NEWS.

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

† It is evident that the addition of a few drops of nitric acid is desirable here to ensure the complete peroxidation of any ferrous compounds which may be present.

‡ It is evident that in presence of fluorides the silica here found will not strictly represent the quantity originally present in the sample.

* CHEMICAL NEWS, vol. xxi., p. 205; *Proceedings of the Philosophical Society of Glasgow* (Chemical Section), 1874 and 1875; &c.

His experiments seem to me to exaggerate the errors of the method greatly. Several times have I got identical results by the use of the molybdic method for separating the P_2O_3 from the soluble part of a superphosphate, and by the use of the oxalic acid method. I always use a measured quantity of the ammoniacal magnesium chloride, but considerable excess of this reagent often produces but little influence on the result—sometimes none."

Direct Citric Acid Method.

The method of Joulie is employed by some chemists of wide experience. In this process the iron, aluminium, and calcium are all retained in solution by citrate of ammonium, and no attempt is made to separate the calcium as oxalate, but the phosphate is at once precipitated from the ammoniacal solution by "magnesia mixture," the precipitate being either ignited and weighed or dissolved in acetic or nitric acid, and the solution titrated with uranium. This method is in many respects similar to that recommended by Frésenius, Neubauer, and Luck.*

Iron-Acetate Method.

A few chemists employ a process of which the following is an outline:—The neutralised hydrochloric solution of an insoluble phosphate (freed from silica) or the aqueous solution of a soluble phosphate, is treated with acetate of ammonium (filtered from the precipitated phosphates of iron and aluminium if their separate estimation is required), and sufficient ferric chloride added to cause the precipitate to appear distinctly reddish; the liquid is boiled well, filtered, and the precipitate washed slightly. It is re-dissolved on the filter in hydrochloric acid, tartaric or citric acid added judiciously to the solution, and then a tolerable excess of ammonia. The alkaline solution should be greenish, not reddish. "Magnesia mixture" is then added in moderate excess, the liquid stirred, and left over night. The precipitated double phosphate is then filtered off, and treated in the ordinary manner. The method gives results agreeing well with the average of chemists of repute. On repetition the results of the two estimations agree within 0.1 to 0.2 per cent.

Phosphates of Iron and Aluminium.

The precipitate of iron and aluminium phosphates produced by treating the cold solution of a sample containing the above metals with an alkaline acetate (or with ammonia and excess of acetic acid) can be very conveniently analysed by the following method, contributed by Mr. R. Warington. "The precipitated phosphates of iron and aluminium are washed, ignited, and weighed, re-dissolved in strong hydrochloric acid, and the iron determined volumetrically with stannous chloride and iodine (see Frésenius). From the iron the quantity of ferric phosphate in the precipitate is calculated, the phosphate of aluminium found by difference, and thus the iron, aluminium, and phosphoric acid in the precipitate are obtained. A little phosphoric acid is liable to be removed from the precipitate during washing, and basic salts are thus reckoned in the calculation as of normal composition."

Estimation by Uranium.

The removal of iron and aluminium by addition of an alkaline acetate in the cold, with determination of the phosphoric acid in the filtrate by means of uranium,† is a method which appears to deserve more extended employment. The use of an acetate in a slightly acid solution brings the liquid into just the condition required for the use of the uranium method. The volumetric estimation by uranium is very highly spoken of by some chemists as convenient and fairly accurate, while others consider it very unsatisfactory. The conflict of opinion is very great,

and special experiments on this process appear desirable, but the following seem to be the precautions necessary for successful working. The proportions of acetic acid and alkaline acetate employed, and the volume of the solution, should be approximately constant. The uranium nitrate should be standardised with an acetic acid solution of pure precipitated ammonio-magnesium phosphate or tricalcic phosphate, instead of with phosphate of sodium, as is commonly done. The titration should be *converse*, the solution of the phosphate being added to that of the uranium. The latter should be mixed with a constant proportion of acetic acid, and heated in a bath of boiling water. The indicator should be powdered potassium ferrocyanide on a white plate. Owing to the reversal of the usual process, the brown colour of the ferrocyanide of uranium becomes gradually fainter till the end of the titration.

This method, which is recommended and employed by some authorities of great experience, is said to be capable of giving results of every desirable accuracy.

The gravimetric method of precipitation by nitrate of uranium is employed by a few chemists, and is very well spoken of.

Molybdic Acid Method.

Of all methods, Sonnenschein's process of precipitation with molybdic acid appears to be regarded the most accurate. All the chemists who refer to it speak of it as extremely accurate, and consider that it is preferable to any other in presence of much iron or aluminium, but comparatively few use it habitually.

The causes of this unpopularity are the time required and the expensive nature of the reagent. As a very large excess of molybdic acid is required above that which is actually precipitated as "phospho-molybdate of ammonium," it becomes an important matter to recover the molybdic acid from the solution. Unfortunately, no very simple process of effecting this appears to have been devised.

The yellow precipitate obtained, containing as it does less than 4 per cent of anhydrous phosphoric acid, becomes very bulky and unmanageable when the weight of phosphoric acid present exceeds 0.1 or 0.2 gm. This fact necessitates the employment of very small quantities of the phosphate; and as the yellow precipitate has to be subsequently re-dissolved and precipitated with magnesia mixture in the ordinary way, the error liable to occur from the use of an unusually small weight of the sample, together with the loss of time and expense incidental to the use of the process, seem to have combined to render the method unpopular for everyday work,* while its value is generally admitted when the above considerations are of little importance.

J. Macagno has recently proposed to reduce the yellow precipitate with zinc and acid, and titrate the solution so obtained with standard permanganate. The test experiments show a maximum error of 0.5 per cent of the phosphoric acid present.

Eggertz's Molybdic Acid Method.

Metallurgical chemists are well aware that M. Eggertz has proposed to weigh the yellow precipitate of "phospho-molybdate of ammonium" instead of re-dissolving it and converting it into ammonio-phosphate of magnesium in the ordinary manner.

This modified plan has the advantage of speed, and the fact that the precipitate contains less than 4 per cent of phosphoric anhydride would render the results extremely accurate.

Unfortunately, it seems improbable that the precipitate

* *Zeits. Anal. Chem.*, ix., 16; and Sutton's "Volumetric Analysis," 2nd edition, page 241.

† It is universally admitted that the estimation by uranium is untrustworthy unless any iron and aluminium present in the original solution is first removed.

* Mr. A. Sibson writes:—"The molybdic acid process is, in my opinion, not suitable for phosphatic minerals, although invaluable for soils, limestones, &c., containing small proportions only of phosphoric acid. The large excess of molybdic acid necessarily employed in the former case is itself a source of error with no adequate advantage, inasmuch as the magnesia precipitate has still to be employed, and it is in the manipulation of this precipitate that the differences in analyses chiefly arise."

has a constant composition, and any sensible variation in the proportion of phosphoric acid contained in it would render it worthless as a method of estimation, at least so far as manures are concerned.

M. Eggertz estimates the anhydrous phosphoric acid contained in the yellow precipitate obtained under the conditions prescribed by him at 3·72 per cent.

Other Methods.

Besides the above-described processes, and trifling modifications of them, descriptions have been received of no other method. The lead, bismuth, and tin processes appear to have fallen into complete disuse. No chemist has reported that he estimates phosphoric acid by precipitating it as tricalcic phosphate by the direct addition of ammonia to the original solution.

(To be continued).

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

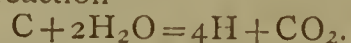
By Dr. A. W. HOFMANN.

(Continued from p. 164.)

SINCE lime partially loses its luminous power by continued use, platinum-wire, magnesia, and latterly zirconia, have been employed in its stead.†

The above-mentioned applications of the hydrogen lamps are, however, of a very limited nature. To utilise it on the large scale for street lighting, the simultaneous use of oxygen has been laid aside, and cheaper methods of preparation have been sought for. For this purpose advantage was taken of Felice Fontana's method of decomposing water by means of ignited iron and ignited carbon, as proposed in 1780.‡ On the latter scheme Donovan founded his industrial preparation of hydrogen gas in Dublin in 1830. His process has been repeatedly described with modifications, referring in part to the needful apparatus, and in part to the diminution of the proportion of carbonic oxide. The presence of this poisonous gas was at first justly urged as an argument against the use of the "water gas." Langlois found that the mixture obtained—on allowing steam to pass over iron retorts filled with red-hot coke in Kirkham's apparatus—had the tolerably constant composition of 58 to 60 per cent of hydrogen, 19 to 26 carbonic oxide, and 15 to 20 carbonic acid.

It was subsequently, however, discovered§ that at higher temperatures carbonic oxide is oxidised by watery vapour to carbonic acid, so that if the steam is in excess a gas may be obtained relatively free from carbonic oxide, as shown in the reaction—



In the water-gas prepared at Narbonne, where the gas on issuing from the retorts is conducted through ignited tubes along with fresh quantities of superheated steam, Verver|| found in 1858, 3·54 per cent of carbonic oxide. According to other observers the amount ranged from 2·5 to 5 per cent. In the water-gas at Passy, Payen found 6 per cent of carbonic oxide, whilst in ordinary coal-gas he found an average of no less than 14 per cent. The above-mentioned objection, therefore, no longer holds good.

The carbonic acid is removed by milk of lime, or, perhaps, more economically, according to the suggestion of Heurtebise¶ by soda, which is thereby converted into bicarbonate, a readily saleable substance.

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† See the work of Phillips, quoted above.

‡ *Mem. Soc. Ital.*, xv.

§ Bromeis, *Zeitsch. d. Ver. deutsch. Ing.*, iii. 82, and *Dingler Polyt. J.*, clxiv. 33, 1859.

|| B. Verver. "L'éclairage au gaz à l'eau à Narbonne et l'éclairage au gaz Leprince." Leiden, 1858. See Bromeis, *opus citat.*

¶ Heurtebise, *Dingl. Pol. J.*, cxcvii. (?), 393, 1867.

Fayes* constructed for lighting the town of Narbonne an apparatus which he named gazogen, which furnished in twenty-four hours 1000 to 1200 cubic metres of purified gas, the cost of which, independent of labour, and of the cost and depreciation of plant, he calculates as follows:—

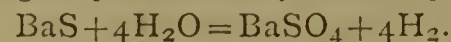
Per 100 Cubic Metres of Gas.

| | f. | c. |
|--|----|----|
| 75 kilometres of coke at 0·03 franc | 2 | 25 |
| 55 " coal at 0·025 " | 1 | 37 |
| 82 " lime | 82 | |
| | 4 | 44 |

The material costs, therefore, 4½ centimes per cubic metre.

Instead of decomposing water by carbon, certain other processes have recently come into use, and require notice.

Lenoir's process,† suggested in 1867, is of very limited applicability. He decomposed barium sulphide with water, obtaining sulphate of baryta and hydrogen—



This process is only practicable where the manufacture of barium sulphate (permanent white) is the main object, and the hydrogen a by-product, as was the case with Lenoir.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.‡

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 166.)

IN whatever way black-ash may be made it varies but little in its composition; and previous to laying before you some analyses of this substance, I will give the analyses of a few specimens of the raw mixing materials. First salt cake:—

| | A. | B. | C. |
|------------------------|---------|---------|---------|
| Insoluble in water .. | 0·112 | 0·073 | 0·042 |
| Free sulphuric acid .. | 0·955 | 1·820 | 0·022 |
| Calcium sulphate .. | 1·139 | 1·148 | 1·046 |
| Iron persulphate .. | 0·682 | 0·588 | 0·322 |
| Sodium chloride .. | 2·632 | 0·234 | 0·744 |
| " sulphate .. | 94·393 | 96·137 | 97·824 |
| Moisture | 0·087 | — | — |
| | 100·000 | 100·000 | 100·000 |

A was from a works making moderate salt cake, in what is technically termed a blind-roaster; B from a works making rich cake in an open roaster; while C was a fair sample of salt cake made by Hargreaves's and Robinson's process. The insoluble matter generally consists of silica, clay, and sand, with which is sometimes associated a basic sulphate of iron.

The part played by the free sulphuric acid in the salt cake when in the black-ash furnace is an obscure one; there is no doubt the majority is roasted off and escapes by the chimney; and that the free acid exerts no injurious influence upon the ball I consider proved by the fact that balls have been drawn containing a minimum of sulphate and sulphide from salt cake, containing 2 per cent of free sulphuric acid.

Second, of limestones. Nothing seems to suit a black-ash worker but the Buxton variety; in his ear the word sounds so melodiously that everything is sure to go well if a Buxton wagon is seen in the yard. There is very little in this though, and any moderately pure limestone may be used in the black-ash process. I give a few analyses of lump limestone:—

* Fayes, *Génie industriel*, 1868, 329. *Dingl. Pol. J.*, cliv. 47.

† Lenoir, *Wagn. Jahresber.*, 1867, 219, 259.

‡ From the *Journal of the Society for the Promotion of Scientific Industry*.

| | Buxton. | Minera. | Ruthin. |
|----------------------|---------|---------|---------|
| Organic matter | traces | traces | traces |
| Silica | 0.106 | 0.442 | 0.398 |
| Alumina | 0.123 | 0.145 | 0.135 |
| Ferrous earbonate .. | 0.187 | 0.348 | 0.252 |
| Calcium.. .. . | 99.372 | 98.298 | 98.370 |
| Magnesium | 0.116 | 0.756 | 0.756 |
| Manganese | 0.013 | 0.022 | 0.026 |
| Calcium phosphate .. | trace | trace | trace |

99.917 100.011 99.937

All of these limestones make excellent black-ash; but it must not be supposed that the crushed limestone supplied to a works is of a purity equal to the above. The analyses are merely given to show the nature and amount of the various constituents other than calcium carbonate, for as used in the black-ash mixing there is invariably present a quantity of clay, sand, and other foreign matters, which largely increase the amounts of silica, alumina, and iron.

The analyses of lime, mud, and of the fished salts will be found further on in other sections.

Lastly, of the mixing slack. It is this constituent of the black-ash mixing which introduces so many objectionable matters into the black-ash ball. This is too often lost sight of, and chemists go rambling over an estimation of the sulphur, a perfectly useless operation, and forget the constituents of the ash. The ashes of slacks vary but very little, and often introduce into the black-ash ball very large amounts of silica, alumina, and iron. The ashes left from different coals have been examined often, and some analyses may be seen in Phillips's "Elements of Metallurgy."

The ashes of slack used in mixing vary a little from the coals; as an example of this I give the following analyses:—

| | A. | B. |
|--|-------|-------|
| Silica | 49.36 | 48.74 |
| Alumina | 26.86 | 22.79 |
| Iron peroxide | 14.00 | 18.76 |
| Lime | 7.07 | 5.43 |
| Magnesia | 0.48 | 0.99 |
| Sulphuric acid (SO ₃) | 1.12 | 2.74 |
| Phosphoric ,, (P ₂ O ₅) | 0.11 | 0.05 |

99.00 99.50

Mixing slack is generally examined for its percentage of ash and sulphur. The former is all important, and generally varies from 7 to 16 per cent, a good sample containing, however, not more than 10 per cent. As to the percentage of sulphur, without it is very large, it may be safely neglected.

Up to 1.5 per cent I have proved that it exerts no injurious action upon the black-ash.

A slack which was producing very good results in the black-ash mixings was examined as follows:—

| | Per cent. |
|--|-----------|
| Sulphur | 1.432 |
| Ashes | 10.000 |
| Carbon.. .. . | 70.122 |
| Nitrogen | 0.286 |
| Combustible matter | 88.590 |
| Volatile sulphur | 1.387 |
| Silica | 4.936 |
| Alumina | 2.575 |
| Iron peroxide | 1.511 |
| Lime | 0.700 |
| Magnesia | 0.052 |
| Sulphuric acid (SO ₃) | 0.243 |
| Phosphoric ,, (P ₂ O ₅) | 0.006 |

100.000

As I have before mentioned the slack is generally examined for its ash and sulphur, also for its moisture in some places. The following are a few analyses of mixing slacks made in this way:—

| | Ash. | Sulphur. | Moisture. |
|----------|-------|----------|-----------|
| 1. 4.46 | 0.724 | 2.41 | |
| 2. 5.77 | 0.986 | 1.00 | |
| 3. 7.41 | 0.937 | 10.14 | |
| 4. 10.84 | 1.116 | 4.72 | |
| 5. 10.96 | 1.736 | 5.11 | |
| 6. 13.42 | 0.543 | 2.98 | |
| 7. 16.76 | 0.431 | 1.22 | |
| 8. 28.96 | 1.774 | 3.44 | |

The nitrogen in the slack is also an injurious constituent. Under the influence of the heated lime and alkali, some of it escapes in the form of ammonia, which, uniting with the free sulphurous and sulphuric acids of the furnace atmosphere, passes away from the chimney in white clouds of sulphate of ammonia mixed with a little cyanide of ammonium. A great deal of ammonia also escapes when the ball is being drawn from the furnace, and even until the ball has cooled very considerably. Another portion of the nitrogen is converted into sodium sulphocyanide, while the remainder goes to form cyanide, from which ferrocyanide is formed in the lixiviating process. It may be worthy of remark here that a well fired ball containing a moderate excess of limestone generally contains less cyanide than one which has been drawn short of fire.

The following analyses from Phillips's "Metallurgy" will give some idea of the amounts of nitrogen present in different coals. Slacks contain less in consequence of the dilution occasioned by the presence of a large quantity of ashes:—

| Description. | Locality. | Per cent Nitrogen. |
|------------------------|-------------|--------------------|
| Bedwas | North Wales | 1.44 |
| Hills, Plymouth works | North Wales | 0.46 |
| Haswell, Wallsend | Newcastle | 1.42 |
| West Hartley Main | Newcastle | 1.69 |
| Staveley | Derbyshire | 1.23 |
| Haydock, Little Delf | Lancashire | 0.54 |
| Ince Hall Co.'s, Arley | Lancashire | 1.76 |

The ball compounded as before described is pitched or dropped into the black-ash furnace, gradually heated and fluxed, being drawn into an iron bogie, when the jets of inflamed carbonic oxide are commencing to diminish in number and intensity. When drawn, however, from the furnace the reaction is not complete, the action continuing until the ball has set and become thoroughly solidified. As an instance of this I give the following analyses, each experiment being made upon the work of six furnaces for a single shift—or, in other words, each experiment is the average of seventy-two balls:—

| | Total soda. | Sodium sulphate. | Sodium sulphide. |
|--|-------------|------------------|------------------|
| 1. Sample taken when drawing balls .. | 26.00 | 2.4 | 0.21 |
| 2. Sample taken from ball bank (cold) .. | 27.00 | 1.2 | 0.29 |
| 3. Sample taken when drawing | 21.00 | 3.5 | 0.14 |
| 4. Sample taken from ball bank (cold) .. | 21.00 | 1.7 | 0.14 |

The time the ball is exposed to the action of heat will, of course, vary with the number drawn per shift. In one works, drawing twenty stone balls with lime mud in the mixing, twelve balls are worked and drawn between the hours of six a.m. and four p.m., whilst in another works it is stated that sixteen of the same balls are drawn between six a.m. and five p.m., and in one firm where twenty-four stone balls are worked, twelve balls are worked and drawn at the same time. The theory of the process I have always adopted, and which seems to be the most correct, is that of Mr. Gossage. It may be expressed in equations thus:—



The proportions of the ingredients used agree very well with the formula in every detail, and when some manufacturers employ an excess of limestone and slack, it is

only for the purpose of mechanically aiding (so to speak) the decomposition, and also for obtaining a large quantity of sodium hydrate in their liquors.

I now give the analysis of some black-ash balls made from the following mixings:—

| | A. cwts. | B. cwts. | C. |
|---------------------------|-------------|-------------|--|
| Salt cake, 96 per cent .. | 2.50 | 2.50 | Supposed to be the same as A. |
| Buxton limestone | 2.75 | 1.50 | |
| Lime mud (Buxton) .. | — | 2.50 | |
| Slack | 1.50 | 1.50 | |
| Fished salts | — | 14lbs. | |

A and B are both good balls, but C is what is technically known as a red or burnt ball, which results from an excess of salt cake and slack in the mixing, or a deficiency of limestone.

The difference between them may be seen in the analysis.

The true composition of the ball, as has been clearly set forth by Kynaston, Muspratt, and others, is undoubtedly a mixture of carbonate of soda, with calcium, sulphide, and oxide, containing also a little carbonate; still, I have calculated the analysis into what is actually soluble and insoluble, so that it may be readily seen what is obtainable as vat liquor, and what portion is left behind as the waste.

| | A. | B. | C. |
|--------------------------|--------|--------|--------|
| Sodium carbonate .. | 28.144 | 31.807 | 28.336 |
| „ oxide | 5.860 | 5.614 | 3.844 |
| „ chloride | 2.808 | 2.574 | 3.101 |
| „ sulphate | 0.192 | 0.190 | 3.037 |
| „ sulphite | 0.151 | 0.072 | none |
| „ hyposulphite .. | 0.189 | 0.853 | 0.126 |
| „ sulphide | 0.358 | 0.163 | 6.645 |
| „ aluminate | 0.344 | 0.752 | 0.923 |
| „ silicate | 1.026 | 0.914 | 0.758 |
| „ cyanide | 0.186 | 0.043 | 0.422 |
| „ sulphocyanide .. | 0.074 | 0.021 | 0.077 |
| Calcium sulphide .. | 29.504 | 28.744 | 33.245 |
| „ carbonate | 12.657 | 9.272 | 6.087 |
| „ oxide | 10.048 | 9.488 | 3.465 |
| Iron sulphide | 0.554 | 0.774 | 1.355 |
| Alumina | 0.172 | 1.042 | 0.624 |
| Silica | 1.095 | 0.923 | 0.973 |
| Magnesia | 0.266 | 0.322 | 0.146 |
| Soda | 0.344 | 0.546 | 0.577 |
| Carbon | 4.263 | 4.483 | 4.958 |
| Sand | 1.237 | 0.875 | 0.842 |
| | 99.472 | 99.479 | 99.646 |
| Soluble iron sulphide .. | | | 0.105 |

The injurious action of the silica and alumina in the mixing materials may be seen in the analyses. Silicate and aluminate of soda are formed, which are soluble, while a double silicate of alumina and soda is left in the black-ash waste insoluble; a manufacturer should, therefore interest himself in keeping his mixing materials as free as possible from these injurious substances. The silicate and aluminate of soda in solution also react upon each other, even at a temperature of 120° F. producing this insoluble double silicate.

This black-ash process should be scientifically overlooked, daily if possible; it is a chemical process, and should be placed under strict chemical superintendence.

The black-ash balls should be carefully sampled from the ball bank, and the results entered in a book in the following form:—

| Date. | Description. | Total Na ₂ O. | Total sulphuras Na ₂ S. Na ₂ SO ₄ . | NaCl. | |
|----------|--------------------------------------|-----------------------------|--|-------|------|
| Dec. 16. | Night work—No } limestone .. } | 22.94 | 2.01 | 0.146 | 4.09 |
| Jan. 6. | Day's work—No } salts } | 19.97 | 2.72 | 0.179 | 1.87 |
| Feb. 4. | No. 4 furnace—A } fresh hand .. } | 24.16 | 3.04 | 0.244 | 4.00 |
| Mar. 8. | Day's work .. | 22.26 | 1.25 | 0.098 | 2.29 |

Results such as these, when accurately kept, form valuable numbers for comparison.

(To be continued.)

THE ATOMIC WEIGHT OF THE CERIUM METALS.

By S. E. PHILLIPS.

SOME time ago I prepared some short laboratory papers on the least known elements, such as glucinum, lanthanum, and others; meanwhile a great interest has been evinced on the subject, and long lists of these combinations have appeared in recent numbers of the *Journal of the Chemical Society*.

In regard to these, there are three alternatives:—(1) The old, the essentially chemical point of view, which regards them as weakly basic and monatomic; (2) that which regards them as di-atomic, of which several lists have been given by men of great eminence; and (3) the triatomic point of view, which is the most recent.

We now propose to condense our remarks into one paper on the group cerium, erbium, lanthanum, didymium, glucinum, and indium, such congeners having many close, chemical, and even isomorphous relations.

The great differences of opinion as to the atomic values of the chemical alphabet prompt the enquiry as to what can be done in the way of placing the matter before some crucial standpoint, so as to promote a more unanimous settlement.

Time was when the old chemists fought valiantly for the faith, but all martial energy seems to have died out, with the ignoble defeat of the illustrious Swede.

A short time ago, an anonymous trumpet blew a threatening blast from Burlington House, which took immediate effect, in so far that the *Journal of the Chemical Society* ceased to mutilate the notations of M. Berthelot and other eminent chemists; but, as a rule, these great men are content to see, with quiet satisfaction, that every accession of new knowledge adds force and clearness to the older atomic weights.

It seems to me a cardinal point with many to consider the elements as blank units which may be played with numerically; they coldly and grudgingly accept the Daltonic proportions, and seem to consider it immaterial whether an element be $x\text{Cl}$, $x_2\text{Cl}_2$, or $x_3\text{Cl}_3$, excepting so far as volume or specific heat may determine.

On the contrary, we maintain that electro considerations are all paramount, and that, if any element be di- or tri-atomic in relation to O or Cl, it will evince this negative quality in the negative or acid character of its typical combinations; and, conversely, that if monatomic, it must necessarily evince a combining portrait of basic features.

Mercury, platinum, and gold may be found as proto-oxides or chlorides; but they are typically, or most naturally, either bi or tri, and their consequent negative or acid behaviour is plainly evinced in every portrait, by whomsoever drawn.

We have strongly urged these considerations in regard to the metal indium (CHEMICAL NEWS, vol. xxvi., p. 2), and they are as fully paramount in relation to the cerium group generally, where the predominant basic features plainly indicate their proto-electro characters.

Why, indeed, should the tribasic succinates or tartrates, the monobasic acetates, the tribasic cyan-ferrates or cobaltates, the proto-cyan-platinates, and others, so exactly agree with the well-known corresponding types of sodium and potassium.

Well indeed may Professor Wanklyn protest that many diatomics were doubled on very insufficient evidence; and Watts, in his esteemed "Dictionary" (p. 226), states that "in anorthite and other minerals, when alkali metals are replaced isomorphously by calcium, that such replacement takes place in equivalent proportions, e.g., 39 parts of K by 20 of Ca."

How intensely hypothetic is the notion of polyatomic properties *per se* will be fully seen by any fair appreciation of the purely *relative* character of chemical affinity.

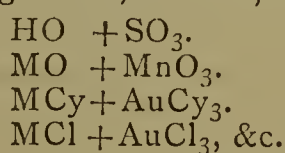
Let us compare in this way O and S with their two bonds, hooks, or points of attachment; with Cl or H, which have only one.

Antithesis of electro-property is the universal bond of strongest uniting force, producing in chemistry the simplest types and the most definite chemical characters; hence the remote unions of Cl or S are similarly proto in character, and the double oxides, chlorides, or sulphides all evince the same general distinguishing peculiarities. One representation will suffice for either:—

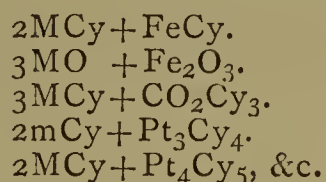
| | |
|----------|---|
| MgS + HS | These are definite crystalline salts, and have many characters in common. The lowest three bear a red heat without decomposition, and several of the others stand a very high temperature, while the Mg salt exists only in solution. |
| CaS + HS | |
| SiS + HS | |
| LiS + HS | |
| BaS + HS | |
| NaS + HS | |
| KS + HS | |
| AmS + HS | |

The simple types and great strength of character of the alkaline oxides, chlorides, or sulphides are too well known to require emphasis, and therefore it is we call attention to the same law among salts. Ascending the scale above magnesium, we pass intermediate sesqui and other varied ratios, and find an opposite region of simplest type, where H has an inverted position.

As the *negative* remoteness of H gives strength and simplicity to the alkaline oxyhydrates or sulphhydrates, so the *positive* remoteness of H in relation to the higher acids, gives another strength and mono simplicity, as in the sulphates, manganates, aurates, &c.



The intermediate types being normally di-, tri-, or sesqui-basic, with a tendency to an endless variety of complex ratios. Some of the most normal intermediate types are:—

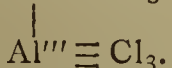
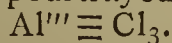


Of course, this law of typical progression can be more simply estimated in the elementary series, as compared with the + or alkaline extremity on one side, and the negative or chlorous on the other.

| | | | | | |
|---------------------|---------------------|---------------------------------|---------------------|-----------------------------------|-------------|
| 1 to 7—1 to 5. | 1 to 3. | 1 to 2½. | 1 to 2. | 1 to 1½. | 1 to 1. |
| —ClO ₇ . | BiCl ₃ . | W ₂ O ₅ . | HgCl ₂ . | Al ₂ O ₃ . | FeO. |
| ClO ₅ . | SO ₃ . | S ₂ O ₅ . | SnO ₂ . | Fe ₂ Cl ₃ . | BaCl. |
| NO ₅ . | AuCl ₃ . | | PtCy ₂ . | Co ₂ Cy ₃ . | NaO. |
| PO ₅ . | MnCy ₃ . | | SiO ₂ . | | KCy, \&c. + |
| AsO ₅ . | | | CS ₂ . | | |

A non-recognition of these simple facts, and the universal law they exemplify, has overlaid a beautiful science with conflicting hypotheses of atomicities, quantivalences, &c., and some way out of the chaos seems anticipated, if not prayed for by all.

Confused conceptions can never lead to a clear and simple nomenclature; the atomic weight of aluminium is first of all doubled, and then, to make it "a tetrad of even atomicity," it is again doubled, so that the chloride may have its atomicity thus portrayed:—



This ingenious device satisfies the four hooks or points of attachment; and the rising generation of chemists receive such intellectual pabulum, and are satisfied.

Accustomed to such barbarous terms as hydrochloric acid, &c., and taught to despise the indications of electro-

law, the student sees no incongruity in a hydrate of alumina, $3\text{HO} + \text{Al}_2\text{O}_3$.

Like H, Al has a midway position, and may be either chlorous or basylous. We may have a sulphate of —Al, because it is basic, or + to the higher or more — acids; but it is chlorous, or more —, to H and the earthy and alkaline metals, and hence the minerals—

Spinnelle as an aluminate of Mg, $\text{MgO} + \text{Al}_2\text{O}_3$.
Diaspore " " " H, $2\text{HO} + \text{Al}_2\text{O}_3$.
Or the artificial " " " H, $3\text{HO} + \text{Al}_2\text{O}_3$.
And the chlor-aluminate of Na, $3\text{NaCl} + \text{Al}_2\text{Cl}_3$.

As in biology some species are tenaciously proud of caste, and hold their position with a haughty exclusiveness, while others flirt to various changes of relative position, so in minerals the same peculiarities subsist.

Clever, indeed, would be the chemist who could persuade aluminium to depart in any way from its select sesqui position, while manganese may be found among the proto bases, and through intermediate stages up to the higher acid types.

Glucinum is a little-known element of great interest, as being the lightest of all metals, with a weight less than five-fold that of hydrogen.

| | Mono. | Di. | Tri. |
|-----------------|-------|--------|-------|
| Glucinum | 4.70 | 9.40 | — |
| Yttrium | 29.85 | 58.70 | 88.5 |
| Indium | 37.80 | 75.60 | 113.4 |
| Cerium | 46.00 | 92.00 | 138.0 |
| Lanthanum | 46.38 | 92.76 | 139.0 |
| Didymium | 47.92 | 96.00 | 144.0 |
| Erbium | 56.85 | 113.70 | 170.5 |

P. T. Cleve suggests that Ce, Di, La, Er, and Y form one group of triatomic elements, that Ce and La are an isomorphous sub-group and Y and Er another, and Di intermediate with affinities to both.

Marignac, from a diatomic point of view, notates the chloro-platinates of Ce, La, and Di as isomorphous, also the nitrates of La and Di, that phenakite and willenite are isomorphous silicates—



Rammelsberg considers the erbium salts mostly contain the same HO as the zinc and Mg salts, and that the sulphate is isomorphous with cadmium sulphate.

Combinations of the Cerium Group.

| | | |
|--------------------|----------------------------------|---|
| Ides, | MO. | |
| " | MCl. | |
| " | MS. | |
| " | MCy. | |
| Seme, | M ₂ O ₃ . | |
| " | M ₂ Cl ₃ . | |
| Chlorates, | MO | + ClO ₇ . |
| " | MO | + ClO ₅ . |
| Iodates, | MO | + IO ₅ . |
| Nitrates, | MO | + NO ₅ . |
| Ortho-phosphates, | 3MO | + PO ₅ . |
| Pyro-phosphates, | 2MO | + PO ₅ . |
| Meta-phosphates, | MO | + PO ₅ . |
| Sulphates, | MO | + SO ₃ . |
| Sulphites, | MO | + SO ₂ . |
| Selenates, | MO | + SeO ₃ . |
| Selenites, | MO | + SeO ₂ . |
| Acetates, | MO | + (C ₄ H ₃ O ₂)O. |
| Formates, | MO | + C ₂ H ₁ O ₂ , O. |
| Carbonates, | MO | + CO ₂ . |
| Oxalates, | MO | + C ₂ O ₄ , O. |
| Silicates, | 2MO | + SiO ₂ . |
| Succinates, | 2MO, HO | + C ₈ H ₃ O ₄ , O. |
| Tartrates, | 2MO, HO | + C ₈ H ₃ O ₈ , O. |
| Chloro-platinates, | MCl | + PtCl ₂ . |
| " | MCl | + PtCl. |
| Cyano-platinates, | MCy | + PtCy. |
| Cyano-ferrates, | 2MCy | + FeCy. |
| " | 3MCy | + Fe ₂ Cy ₃ . |
| Cyano-cobaltates, | 3MCy | + Co ₂ Cy ₃ . |
| Sulpho-cyanates, | MS | + CyS or (CS) ₂ MN. |

Double Salts.

| | |
|--------------------|---|
| Sulpho-cerates, | $\text{KO}, \text{SO}_3 + \text{CeO}, \text{SO}_3$. |
| Sulpho-glucimates, | $\text{KO}, \text{SO}_3 + \text{GLO} + \text{SO}_3$. |
| Other types, | $\text{KO}, \text{SO}_3 + 3\text{CeO}, \text{SO}_3$. |
| " " | $\text{KO}, \text{SO}_3 + 3\text{YO}, \text{SO}_3$. |
| Carbo-cerates, | $\text{KO}, \text{CO}_2 + 3\text{CeO}, \text{CO}_2$, &c. |

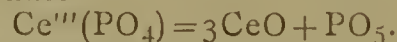
The work of translating these mono equivalents out of the curiously-contrived confusion of di- and tri-atomic types has been a task of severe labour. M. Cleve's pyrophosphate of Di = $\text{Di}'''_4(\text{P}_2\text{O}_7)_3$; therefore, by multiplying—

$$\left. \begin{array}{l} \text{Di} \times 3 \times 4 = 12 \\ \text{P} \times 2 \times 3 = 6 \\ \text{O} \times 2 \times 7 \times 3 = 42 \end{array} \right\} = 6 (2\text{DiO} + \text{PO}_5).$$

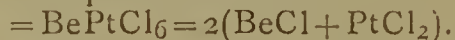
M. Jolly's pyrophosphate of Ce is—



His ortho-phosphate—

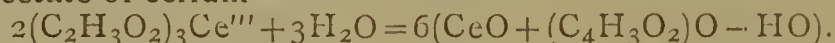


Atterberg's chloro-platinate of Gl =



There is a symmetry in my acetates, formates, and oxalates, but what may we say of M. Jolly's?

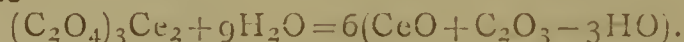
Acetate of cerium—



Formiate—



Oxalate—

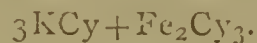


Among cyano-salts, my platinates, ferrates, and cobaltates have strictly normal types, such as abound with earthy and alkaline metals, but they are derived from a curious assemblage.

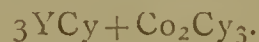
M. Jolly's cyan-ferrate =



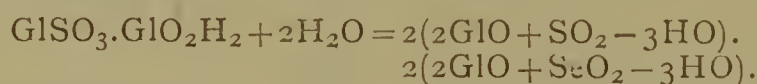
Like the well-known red prussiate—



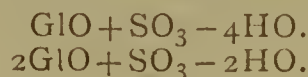
There is also a yttrium analogue—



The following equivalents are not at all easily seen, but will be found to be correct. Atterberg's sulphite and selenites are thus:—



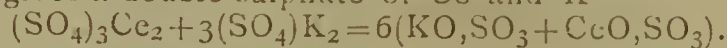
He has two sulphates—



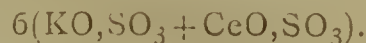
And a pyrophosphate—



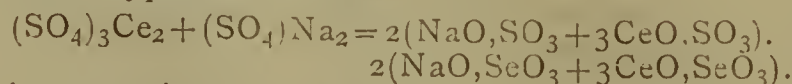
It is still more difficult to find the meaning of the double salts, nor is it scarcely worth the prolonged effort; for with weak generic forces of combination it is easy to imagine crystalline forms of very varied ratios, as dependent on temperature, the strength of solutions, &c. M. Jolly gives a double sulphate of Ce and K—



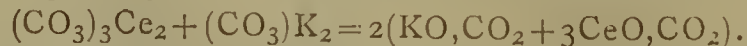
And a corresponding selenate—



Also another type of both these acids—



His carbo-cerate is—



The laboratory part of this paper consists in urging that these atomicities are capable of clear and immediate settlement.

As an angel from heaven is admittedly incapable of impressing belief on those who will not see, I am far from supposing that all may be convinced; but, to very many, the following amount of evidence may be deemed fairly conclusive:—

(1). Let it be shown that the mono weights are those

which are eliminated in the electrolytic circuit, in relation to H 1 or Ag 108.

(2). Let it be shown that the mono weights are those which replace one H, or equivalent radical, in ammonia or other substitutional body.

The sulphocyanates already obtained will be, in the judgment of many, sufficiently conclusive; as Hofmann's phenyl-sulphocyanate is $(\text{CS})_2(\text{C}_{12}\text{H}_5)\text{N}$, so a cerium-sulphocyanate would be $(\text{CS})_2\text{CeN}$, and similarly with most of the others already obtained. The admission that we may have sulphocyanates which are not true ammonias in no respect alters the strength of the argument that, whatever may be the type, ethyl, cerium, or yttrium stand in the place of, and are equivalent to, one H.

It may be well, however, to look for other ammoniacal forms, such as—

Potassium amide, H_2KN .

Cerium " H_2CeN , &c.

We might have a fuller development of the simpler double saltic types, and why not a cerium or glucinum alum?

M. Rössler has chivalrously taken the field in this direction, but, after looking far and wide, I in vain look for his atomic weight.

"The specific heat of indium requires its equivalent to be 113.4, and leads us to ascribe to its oxide the formula In_2O_3 . Hitherto, this view has been unsupported by facts, but M. Rössler has succeeded in obtaining the alum of indium and ammonium, $\text{In}'''_2(\text{SO}_4)_3\text{NH}_4\text{SO}_4 + 24\text{H}_2\text{O}$." —(CHEMICAL NEWS, vol. xxviii., p. 227.) Here we have a complex assemblage of mono-, di-, and tri-atomic elements, still further confused by clerical error (such being the most charitable interpretation). I therefore challenge the entire result?

We have thousands upon thousands bequeathed and otherwise devoted to the prosecution of original research; and, while these munificent appropriations are the outcome of a wide bewailment of English backwardness in this direction, while we have public laboratories, collegiate and other classes, devoted to practical demonstration and research, is there no one spot in this enlightened country where we may hopefully look for a solution so simple and so pregnant as some of the points here desiderated?

Cerium and some of the other analogues have a decided tendency to the sesqui type, and an alum may certainly be looked for as an easy triumph.

NOTICES OF BOOKS.

*Notes on the Detection of Dye Drugs Used for Colouring Wines.** By Dr. R. STIERLIN, of Luzern. Leipzig: J. A. Barth.

"AMONGST all articles of diet none are so much exposed to adulteration as wines, especially red wines. The manufacture of red wine, for so we may call it, has been created on the one hand by the exorbitant duties which certain governments and municipal authorities levy upon wine, and on the other by the desire to accumulate wealth in a short time with a minimum outlay of labour and capital. That there are people who offer in return for certain fees to impart full instructions how to prepare wine without 'grapes,' and who term themselves 'chemists,' can be learnt from the advertising columns of Swiss and German papers. That the investigation of red wines must form an important part of food analysis is easily to be seen. Much has been already written by chemists on the detection of the adulterations of red wines, and many of the instructions do not say how much of the reagents should be employed. Consequently discordant results must be obtained according to the proportions used."

The author takes a certain amount of wine, *e.g.* 250 c.c., and adds to it basic acetate of lead as long as

* "Notizen über Erkennung der Farbstoffe welche zum Färben des Wein es benutzt werden."

a precipitate is produced. This is collected upon a filter, repeatedly washed with distilled water and dried at 100° C. It is then ground up to a not very fine powder and introduced into a glass tube drawn out below to a point with a small aperture and plugged with cotton. About 25 c.c. of ether, previously saturated with hydrochloric acid, are then poured over it, and after it is drained off the operation is repeated with the same quantity of hydrochlorised ether. It is desirable that the ether may percolate slowly in order that the oxide of lead combined with the colouring matter of the wine (so-called œnolin, $C_{20}H_{10}O$) may be perfectly converted into lead chloride. The precipitate is then repeatedly washed with pure ether, in which the colouring matter is insoluble, in order to remove the excess of hydrochloric acid. For this purpose six applications of 10 c.c. each are generally sufficient. The tube is then dried in the air-bath, a current of air being preferably drawn through it from the mouth to the point by means of an aspirator. When dry the tube is fixed air-tight into a flask, and the upper or wide end is fitted with a perforated cork and a rather long bent tube, forming a so-called Anthon's extractor, in which 50 c.c. of alcohol at 36° by repeated distillation and reflux withdraws all the red vinous pigment from the lead precipitate. In all genuine wines this lead precipitate becomes a pale flesh-colour after the third treatment, and white by the fourth or fifth, whilst the alcohol takes a fine red colour. If the 50 c.c. of alcohol are now made up to 250 c.c. with distilled water the colouring matter is in its original state of dilution. This solution is not very stable, and deposits reddish-brown flakes after standing twelve to twenty-four hours. The alcoholic solution is very permanent. This colouring matter was then submitted to the action of certain reagents in comparison with the following colouring matters, boiled in white wine:—logwood, peach-wood, papaver rhœas, hollyhock, cochineal, litmus, magenta, carrot-juice, and with the fermented juices of bilberries, cherries, and elder-berries. Each of these liquids were then tested both alone, and mixed with 70 per cent. of genuine red wine. The reagents employed were:—2 c.c. ammonia at 10 per cent, with 0.5 c.c. sulphide ammonium to 25 c.c. of the sample. After filtration the liquid was made up to 100 c.c. with distilled water. The colour of the precipitate, if any, was judged on the filter. Second. 2.0 (grms.?) manganese peroxide to same quantity; the whole shaken and filtered after ten minutes. Third. 25 c.c. solution bicarbonate of soda containing one-twelfth of dry material. Quantity of sample the same, and the filtrate made up with distilled water to 250 c.c. Fourth. 2.5 c.c. pure concentrated nitric acid and to 25 c.c. sample; heated in the water-bath for ten minutes to 85° to 90°. Fifth. 0.625 (grms.?) peroxide of barium and 25 c.c. of sample; allowed to stand for twenty-four hours with occasional shaking, and filtered. Sixth. 5 (grms.?) zinc; 2 c.c. concentrated sulphuric acid; 25 c.c. of the sample; filtered after twenty hours. Seventh. 100 c.c. solution of alum (8 per cent.), 100 c.c. of sample and precipitate, with 100 c.c. of solution of carbonate of ammonia at 10 per cent; the colour of the precipitate is examined on the filter, moist. Eighth. Basic acetate of lead added to 250 c.c. of the sample as long as a precipitate is produced. The colours of the precipitates are examined when dry, when treated with hydrochlorised ether; the colour of the ether, the colour of the residue dissolved in 30 c.c. of water by the acid of excess of ammonia; the colour of the lead precipitate after treatment with 50 c.c. of alcohol at 36°; colour of 10 c.c. of the alcoholic extract with $\frac{1}{2}$ c.c. and 1 c.c. of ammonia, and the colour of one-half of the extracted lead precipitate treated respectively with $\frac{1}{2}$ c.c. ammonia, and extracted with 10 c.c. water, containing 2 per cent. hydrochloric acid, and the red extract mixed with 3 c.c. ammonia.

We regret that space does not allow us to insert the valuable tables of the colours produced by all these operations.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 11, September 13, 1875.

Fatty Matter of the Seed of the Chinese Oil-Tree.—M. S. Cloëz.—*Elæococca vernicia*, the oil-tree of China and Cochin China, is a plant of the family of the Euphorbiaceæ. Its seeds, when submitted to strong pressure in the cold, yield about 35 per cent of a liquid oil, colourless, inodorous, and almost insipid. Its specific gravity at 15° is 0.9362. At -18° it thickens without losing its transparency or crystallising. By treatment with ether 41 per cent of oil can be extracted from the seed, slightly coloured, but presenting otherwise all the characters of the oil obtained by pressure. If instead of ether purified bisulphide of carbon is employed, the fatty matter remaining after the solvent has been evaporated off at 100° solidifies on cooling, forming a number of small reniform masses, which present under the lens a decided crystalline texture. This solidified fat has the same elementary composition as the liquid oil obtained by pressure, and melts at 34°. The oil extracted by pressure in the cold is rapidly solidified by light in the absence of air, an effect which, on further experiment, was found due to the more refrangible rays of the spectrum alone. The oil of *Elæococca* is the most drying of all oils. If spread on a plate of glass or metal it dries in a few hours on exposure to the air.

Certain Reactions of Hæmoglobin and its Derivatives.—M. C. Husson.—Hæmoglobin on absorbing iodine splits up into hæmatin and globulin. This fact is proved by the spectral analysis, which gives between C and D the absorption-ray of hæmatin, which does not seem to be affected by the iodine. Chautard has already shown that this element has no influence upon the rays of chlorophyll. The microscope also indicates the splitting up of hæmoglobin. With bromide of potassium we obtain crystals of hydro-bromate of hæmatin, of a rosy tint. On treating blood with borax and glacial acetic acid we obtain all the crystals described by MM. Robin and Verdeil in their "Traité de Chimie Anatomique" under the name of hematoidin. Glacial acetic acid alone gives, without the aid of any other reagent, fine crystals of acetate of hemine.

No. 12, September 20, 1875.

With the exception of an article on the discovery of gallium, particulars of which appeared in the CHEMICAL NEWS for October 1, this issue contains neither chemical nor physical matter.

Moniteur Scientifique, du Dr. Quesneville, September, 1875.

Researches on the Gastric Juice.—Richard Maly.—Already noticed.

Contributions to the Knowledge of Alizarin and of Oxyanthraquinon.—Conrad Willgerodt.—Already noticed.

Antiseptic Action of Salicylic Acid.—C. Neubauer.—The author considers that salicylic acid will be of great value in the preservation of wines, but that it is rather adapted to prevent, than to cure, morbid changes in this liquid. He mentions that a wine merchant had bought a hydrometer in the expectation that it would show him the quantity of acid in his must!

New Communications on the Effects of Salicylic Acid.—M. H. Kolbe.

Salicylic Acid in Veterinary Practice.—Dr.

Action of Salicylic Acid as a Medicament.—Dr. Fontheim.—Important papers on the medical applications of salicylic acid, especially in the treatment of diphtheria.

Action of Organic Acids and their Anhydrides upon the Natural Alkaloids.—G. H. Beckett and C. R. A. Wright.—From the *Journal of the Chemical Society*.

Dilatation and the Specific Heat of Alloys and their Relations with the Law of Dulong and Petit.—M. W. Spring.—Two powerful motives originating in modern scientific theories have led physicists to admit that the law of Dulong and Petit on the capacity of the atoms of simple bodies for heat is the expression of a truth. The numerous and delicate experimental verifications to which it has been submitted by distinguished physicists, have shown that it admits of a great number of exceptions, and that a rigorous experimental proof is still wanting. This need not surprise us, for the magnitude measured under the name of specific heat is composed of two factors—the *thermic capacity*, i.e., the quantity indicating the increase of the *vis viva* of molecular movements, and of a quantity which vanishes for the thermometer and is employed to overcome the interior resistance, or to effect the work of disaggregation. The author has determined the expansion and the specific heat of four alloys, those of Rose, $\text{Bi}_7\text{Sn}_6\text{Pb}_4$, of Darcet, $\text{Bi}_{13}\text{Sn}_{10}\text{Pb}_3$, of Lipowitz, $\text{Bi}_{11}\text{Pb}_6\text{Sn}_5\text{Cd}_4$, and of Wood, $\text{Bi}_4\text{PbCd}_2\text{Sn}_2$. Each of these alloys was found to have a point of maximum density. On determining the specific heats of the same alloys, he found that the variations of specific heat follow the variations of volume independently of temperature.

French Perfumery at the Exhibition of Vienna.—This subject will be noticed in due course.

Concentrated Beer.—From the *Standard*.

French Association for the Advancement of Science.—The fourth annual meeting took place at Nantes, on August 19.

Certain Colouring Matters Derived from Aniline.—M. Ch. Lauth.—Reserved for insertion in full.

Varieties in Analytical Chemistry.—M. Neubauer.—These varieties consist of a notice of Landolt's method of determining the molecular weight according to the vapour volume; a short paper on the formation of urea in the bodies of animals; a process for detecting the presence of water in ethereal oils; a note on the detection of bile by Pettenkofer's method; a paper on the determination of uric acid; a notice on the use of chloroform to separate vegetable poisons in chemico-legal investigations; a process for isolating and detecting strychnine in poisoning cases, and researches on the detection of arsenic in the air of rooms.

Archives Néerlandaises des Sciences Exactes et Naturelles.
Tome x., 1me livraison, 1875.

Albuminous Compounds of the Blood-Serum and of White of Egg.—A. Heynsius.—Not suitable for abstraction.

Quantitative Determination of Albumen in Animal Fluids.—A. Heynsius.—For the detection of albumen in animal fluids, especially in urine, the author proposed, in 1870, to add acetic acid until the appearance of a distinctly acid reaction, to mix with the liquid then a few c.c. of a concentrated solution of chloride of sodium, and to boil. This method he still regards as the best and safest, pointing out that the use of nitric acid is objectionable for two reasons: that a reaction may be obtained which simulates the presence of albumen when it is really absent, and that in other cases the behaviour of the mixture may cause its absence to be assumed when really present. For the quantitative determination of albumen, however, the acetic acid and chloride of sodium process cannot be employed.

After passing in review the various known methods, the author recommends the following process:—He commences by separating, by means of dialysis with distilled water the greater part of the salts and all the other crystalloid substances, an operation in which merely a trace of albumenoid passes the parchment-paper. The dialysed liquid, the volume of which must have been determined before dialysis, is then made up to ten times its original measure: 50 c.c. are then taken, and the total solids therein contained are determined. From the figure thus obtained 2 per cent is deducted for alkali, when the remainder shows the amount of albumen.

Determination of Urea in the Blood and in the Tissues.—C. A. Pekelharing.—The author, after an examination of the various known methods, concludes that the determinations of urea in the blood and the tissues hitherto executed merit but a limited confidence; the direct determinations because the nitrate and oxalate of urea are not absolutely insoluble in nitric and oxalic acids, even when concentrated; and the indirect analyses because the products of decomposition which serve for the determination are not characteristic of urea, but may likewise be yielded by other substances. Hence the theories on the origin of urea founded on such determinations are doubtful.

Tome x., 2me livraison, 1875.

Reaction of Chloride of Sulphur with Aniline.—J. A. R. Smit.—The author states that this reaction has been already studied by Claus and Kral (*Deutsche Ber.*, 1871, 99), but that these experimentalists obtained abnormal results, because the diluent agent which they employed interfered with the reaction. M. Smit mixed chloride of sulphur and aniline undiluted, and observed the formation of the violet matter described by Claus and Kral, along with brown vapours. He then employed anhydrous ether to moderate the reaction. When the process was at an end the filtered liquid was distilled in the water-bath to expel ether, and then heated in a retort over the naked flame. Between 180° and 183° the thermometer remained constant, and a little aniline passed over. The temperature stopped for a short time between 220° and 230°, and a yellow oil, of a disagreeable odour, distilled over. After this the thermometer rose abruptly to 250°–280°, at which temperature the mass in the retort became completely carbonised. Vapours still passed over, and condensed in the receiver. The last products, distilling between 220° and 280°, were collected together. After a short time crystals were deposited, consisting of two species, evidently distinct. The one kind were white, silky needles, soluble in ether and alcohol, and fusible at 103°. The others form clear yellow prisms, insoluble in water, but soluble in alcohol.

MISCELLANEOUS.

University of London.—First B.Sc. and Preliminary Scientific (M.B.) Examinations.—Examinations for Honours.—The following is a list of the candidates who have passed the recent examinations:—*First B.A. and First B.Sc. conjointly.*—Mathematics and Mechanical Philosophy: First class. J. Snelling Morris (Exhibition), St. John's College, Cambridge; Sidney White, University College; Frederick Charles Kolbe, University College. Second class. George W. von Tunzelmann, University College; George Charles Frames, Royal School of Mines. Third class. Robert Pickett Scott, Middle Class School, Cowper Street; Richard Henry Chope, Wesley College. *First B.Sc. and Preliminary M.B. conjointly.*—Chemistry: First class. William Hewitt (disqualified by age for Exhibition), Royal School of Mines; Thomas Samuel Humpidge (Exhibition), Royal School of Mines; A. Robinson Willis (disqualified by age for Exhibition), Royal School of Mines; W. Wansbrough Jones, Magdalen College, Oxford. Second class. Greville Matheson McDonald, King's College; Herbert A. H. Fenton, University College; Louis Alfred

Cantin, St. Bartholomew's Hospital; William Joseph Spratling, private study and Royal School of Chemistry. Third class. Alfred Henrick Jackson, Owens College; Archibald McAlpine, Royal College of Science, Dublin; Arthur John Harries, University College; Nanda Kumár Ráy, University of Edinburgh; Richard Bredin, Liverpool Royal Infirmary School of Medicine and private study; William Bartlett Hinton, Guy's Hospital. Experimental Physics: First class. Leonard Charles Wooldridge (Arnott Exhibition and Medal), Guy's Hospital; G. Brown, Owens College; William Hewitt, Royal School of Mines; George William von Tunzelmann, University College. Second class. William Wriothsley Colborne, University College; Cecil Reeves Harrison, University College. Third class. Albert Edward Tovey, private study; Ambrose Robinson Willis, Royal School of Mines.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of soap. Pascal Lombardon, soap manufacturer, of Forest Hill, Kent. October 27, 1874.—No. 3715. The object of my invention is to perfectly saponify all the fatty matters contained in the grease of which the soap is made. This is effected by means of a lye or alkaline compound, consisting of carbonate of soda, quick lime, common salt, and alum.

An improved process for the preservation of animal substances from decay. John Farmerley Dickson, chemist, Leicester. October 29, 1874.—No. 3745. According to this invention the meat to be preserved is cut into joints, and placed first in a bath composed of a saturated solution of borax to which has been added one-fourth part by weight of sulphuric acid; after washing, the meat is placed in a second bath composed of one part of ordinary sulphuric acid diluted with 10 per cent of water; finally, the meat is placed in a third bath of the same composition as that first described.

An improved process of purifying liquids and recovering matter contained therein. George Mackay, manufacturing chemist, Edinburgh, Midlothian, North Britain. October 30, 1874.—No. 3751. The features of novelty which constitute this invention consist in the purification of such liquids as contain animal, vegetable, or mineral matter by the admixture therewith of per-salts of iron, and thereafter adding a caustic or carbonated alkali or alkaline earth, and in the recovery by this means of the matter held in solution or suspension by the liquid so treated.

Improvements in treating aniline and other dyes to prepare them for use in dyeing, printing, and colouring. Maximilian Ziegler, Buckland Crescent, Belsize Park, Middlesex. October 30, 1874.—No. 3757. This Provisional Specification describes dissolving aniline, &c., in bisulphide of carbon, with camphine, turpentine, &c.

Improvements in the treatment and utilisation of sewage, and in means employed therein. Burton Henry Vallé, Stow in the Wold, Gloucester. November 3, 1874.—No. 3784. According to this invention the sewage is collected in filtering tanks, the sludge being completely utilised for the manufacture of illuminating gas and a substance capable of defecating sewage and useful for other purposes, while the liquid portion is rendered fit for domestic use.

Improvements in deodorising and disinfecting materials, and in apparatus for applying the same. Francis Thomas Bond, M.D., Gloucester. November 4, 1874.—No. 3799. The Specification describes the preparation of a disinfecting compound by combining either one or more of the following salts in a pulverulent form, viz, the sulphates or chlorides of iron, alumina, and copper, and the bichromate of potassium, with carbolic acid or with terebene, one of the isomers of oil of turpentine. Also the preparation of a deodorising and disinfecting liquid by the solution of the compounds formed as above in water, or by combination of saturated solutions of the respective salts with terebene or carbolic acid. The Specification further describes a simple form of vessel for attachment to the lid of a water-closet or commode, by means of which a measured quantity of the disinfecting solutions thus formed may be projected into the pan.

An improved artificial fuel. Frederic Dixon, Southgate Road, Islington, London. November 11, 1874.—No. 3880. The use of dextrine, fusel oil, and soda alum in the manufacture of artificial fuel composed of coke, peat, or small coal disintegrated.

Improvements in the treatment of spent oxide of iron, for the purpose of extracting cyanogen compounds therefrom. William George Valentin, of the Royal College of Chemistry, South Kensington, Middlesex. November 12, 1874.—No. 3908. The washed "spent oxide" is digested at the temperature of boiling water with carbonate of lime, with carbonate of magnesia, or, by preference, with slightly burnt dolomite or magnesian limestone. The aqueous solution after filtration contains ferro-cyanogen as ferro-cyanide of calcium or magnesium, as the case may be, or of both, and constitutes a light yellow, very slightly alkaline liquid, which, on the addition of a small quantity of acid and of a salt or salts of iron, yields a precipitate of Prussian blue. The process is equally applicable in the case of "spent oxide" from which the soluble salts have been removed by water, and the sulphur by extraction with carbon disulphide. The ferric-oxide which is then left, and which usually contains some magnesia salt which has not been acted upon, is improved thereby, and can be used over again for the purification of coal-gas.

NOTES AND QUERIES.

Rendering Wood Incombustible.—Can any of your readers inform us what chemical preparation will render wood non-combustible? Will tungstate of soda do it effectively?—A. K. & Co.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 829.

THE YORKSHIRE COLLEGE OF SCIENCE.

An occasion of such importance to the county of York as the inauguration of the College of Science at Leeds, last week, by the Duke of Devonshire, merits more than a passing reference. Stimulated by the example of Owens College, Yorkshiremen in general, and Leedsmen in particular, are attempting to do for their county what the men of Manchester in general, and John Owen in particular, have already done for Lancashire. The people of Leeds, however, distinctly disclaim the idea that the College is in any sense a local institution. That it has been located in Leeds arises simply from the fact that this town is the largest in the district, that it is the centre of a great variety of manufacturing industries, and is the converging point of several extensive railway systems. There is no reason, as Mr. W. E. Forster told his constituents, why the people of Bradford, of Halifax, or of Huddersfield, should not equally regard it as their College. Representative men from these and from every other important town in the Riding are on its executive, and have assisted in its establishment, either by their money or their counsel. In commercial and municipal matters there is a healthy rivalry between these towns, which has shown itself in the number of excellent institutions and good works which it has called forth, but in the special labour of organising the College we are glad to see the towns working in a common cause and to a common end. When we bear in mind that our manufacturers are now fully alive to the fact that foreign competition is seriously telling upon their supremacy, and that the cry for instruction in those sciences which are at length beginning to be recognised as constituting the basis of our chief industries is being heard in almost every large town in the country, it seems extraordinary that the men of the West Riding, who are so intimately dependent on applied science, should have delayed their effort so long. The fact is, as Mr. Forster told the people of Leeds, that the call which has been made by civilisation upon civilised people had been more quickly responded to by Germany, Switzerland, Holland, and even by Sweden and Norway, than by England. We have a habit of being late, and we may congratulate ourselves if our tardiness and procrastination has not thrown us irretrievably behind.

The Yorkshire College of Science has grown out of the labours of the General Council of the Yorkshire Board of Education. Fully impressed with the necessity that something must be done to improve the character of those industries in the district which rest upon applied science, they drew up a scheme which contemplated the supply of the highest standard of instruction in chemistry, mining, and metallurgy, civil and mechanical engineering. Recognising, too, the source from which much of the aliment of the College must come, they sought to make provision for the education of teachers to be employed in the ordinary science schools of the district. The result of their appeal to the country in furtherance of these objects has been that a sum of about £36,000 has

already been collected. The Duke of Devonshire and Sir Andrew Fairbairn have each given £2000; Sir Titus Salt, Messrs. Beckett and Co., Messrs. Hargreaves and Nussey, and the Low-Moor Iron Company have each given £1000; and more than sixty noblemen and gentlemen have given sums varying from £250 to £500. The Endowed Schools Commissioners have made over an endowment of £400 a year, and the Worshipful Company of Clothworkers of the City of London have created an endowment of £300 a year and have founded several scholarships. Although only in temporary premises, the College is very comfortably situated in regard to teaching appliances and conveniences. It possesses good lecture-rooms, an excellent chemical laboratory, a private laboratory for the Professor of Chemistry, rooms for the balances, and for gas analysis and spectroscopic inquiries, a large lecture and loom room for the department of textile industries, private rooms for the Professors, students' room, and other offices. The amount of public support which the scheme has met with is very gratifying, but much remains to be done; and, if the College is to be worthy of the great county from which it takes its name, additional efforts must be made. We should like to see its curriculum extended, and the scope of its teaching considerably enlarged. We trust that Yorkshiremen will not see an institution launched under such favourable auspices starved or crippled for want of the necessary funds. It must be remembered, as the Duke of Devonshire pointed out, "that colleges and institutions for higher education have a very voracious appetite, and that, with great advantage to the public, they could lay out almost any amount of money the public bestowed upon them."

FUNNELS WITH AUXILIARY VERTICAL TUBES

By P. CASAMAJOR.

IN a recent number of this publication (see CHEM. NEWS for July 30, 1875) I have given descriptions of two new funnels, suitable for filtration under pressure. One of these, which is intended to be used in the manner proposed by Dr. Carmichael, must be assisted by an aspirator, on account of the necessity of holding the filtering disc and perforated metallic plate upwards against the funnel. The other funnel, intended for downward filtration, may be used either with an aspirator or simply with an auxiliary vertical tube, which, by holding a column of water, produces the necessary suction.

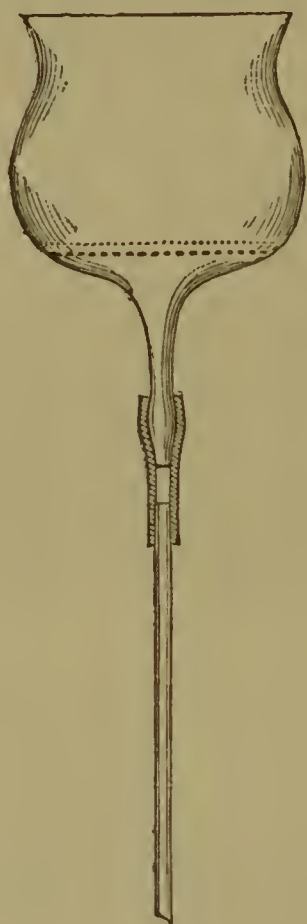
Since the publication of the above-mentioned descriptions, I have had occasion to see this latter funnel tried with a vertical tube by persons whose only instructions were derived from those descriptions, and I regret to say that the results obtained were not satisfactory. This circumstance induces me to return once more to the subject, with the hope that the instructions about to be given will be found so explicit as to afford sufficient guidance.

The annexed sketch and the description which follows, present the shapes and dimensions which have given the best results. In the funnel may be seen the paper filter and metallic perforated plate, the former being represented by a fine dotted line, while the latter is shown by a line of coarse dots. The stem of the funnel ends in a slightly expanded portion, which is intended to prevent the rubber tube from slipping off. The rubber tube also goes over a glass tube whose diameter need not be greater than $\frac{1}{8}$ th of an inch. The length of it need not be

greater than 14 or 15 inches, which would make the distance from the perforated metallic disc to the lower end of the glass tube, about 18 inches.

To use this funnel so arranged, a perforated metallic disc is taken, and over it is placed a paper disc with a diameter about $\frac{1}{4}$ inch greater, in such a way that the two discs are concentric, so that the border of paper left beyond the plate is of the same width all around. Afterwards the paper is soaked with water, which makes it adhere to the metallic disc, and both are placed in the funnel, the paper funnel above the perforated disc.

We may now lay the borders of the paper disc down on the funnel by pressing with the fingers. After this, if we move the paper disc horizontally, we will see that the filter does not adhere to the funnel; and if we should put water in the funnel, the filter will probably become displaced. If we should put in the funnel a liquid holding a precipitate, the turbid fluid would find its way under the filter and descend into the vertical tube. This constitutes the difficulty to which I have referred as having been encountered by persons using these funnels. To



One third of actual size.

insure the satisfactory working of these funnels with a vertical tube, it is necessary to make the paper disc adhere to the bottom of the funnel before attempting to use it for filtration. This is easily accomplished by pouring into the funnel a certain quantity of water after the borders of the funnel have been pressed down. While the water is being poured in, the disc should be held down with a finger to keep it in its place. After the water has run out of the funnel, we may observe whether the vertical tube remains full of water. If the tube remains empty, the borders of the paper disc must be pressed down all around, and a new quantity of water must be poured into the funnel as before. If, after all the water has left the funnel, the vertical tube remains full, it shows that the paper disc adheres to the funnel, and the apparatus may be considered ready for filtration. If now we try to move the filter horizontally in the funnel, we will find that it is a difficult matter to accomplish, as the suction caused by holding up the column of liquid in the vertical tube makes the paper disc adhere strongly to the funnel. If we now pour a liquid into the funnel, we may observe that it runs very rapidly through the paper disc until the funnel is empty, but that, after it has run out, the tube remains full of water

as before. This shows that although the paper disc allows water to run through it very readily, it seems impermeable to air, which may be due to this, that when the paper is, so to speak, saturated with water, its texture becomes looser and more porous, and allows water through it easily, but when it has become partially dry from the suction due to the vertical column of water in the tube, its texture contracts and becomes closer, so that no air can pass through it to satisfy the vacuum under the filter. Were it not for this property of the porous material of the filter, it would not be possible to use a vertical tube with these funnels instead of a filter pump. We may also see that it would be quite impossible to use a conical funnel in this manner, as, in these funnels, there are always channels for the air in the folds of the filters, and a vertical column of liquid could not be maintained.

I have already called attention to the great superiority of these funnels over ordinary conical funnels for washing precipitates. The whole of the liquid used for washing has to go through the precipitate, and not partly over it, as in conical funnels. The precipitate left on the paper disc is also much drier than happens with precipitates on conical filters unassisted by aspirators. A precipitate of iron peroxide, five minutes after the last wash water has passed through it, is so dry that it leaves but a slight stain on a finger pressed on it, and has already begun to crack into little slabs which may be separated from the filter without difficulty.

The condition of dryness in which a precipitate is left with this filter, has induced me to try it for washing commercial sugars with alcoholic solutions of pure sugar, as in the Payen-Scheibler process. The results obtained have been so satisfactory, that I no longer use the filtering pump for this purpose. When quite a number of samples have to be washed at the same time, the funnels with vertical tubes present this superiority over the arrangements now in use, that every funnel has in its vertical tube an independent aspirator. I propose to return to this subject in a future paper on the Payen-Scheibler process.

Instead of a paper disc, a very good filter may be made by pouring a small quantity of thin paper pulp over the perforated plate previously placed in a funnel. This paper pulp is very soon drained of its water. It coats very evenly the top of the perforated disc and the interior of the funnel a little above the edge of the metal disc. Paper pulp is very readily prepared by disaggregating filtering paper in water. A pulp is also readily made from asbestos, which may be freed by washing from any clay or fine dirt. Asbestos is very well adapted for filtering strong acids or alkaline solutions.

A very good filter for mercury is made by using a perforated iron plate, over which is poured a pulp of paper or asbestos. This must be allowed to dry, as, when wet, mercury will not filter through it. For mercury a filter pump must be used, as it runs through the filter in mere dribblets, even when a powerful suction is used.

471, Lafayette Avenue, Brooklyn,
Sept. 15, 1875.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

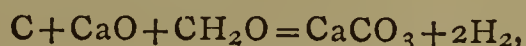
(Continued from p. 164.)

TESSIE DU MOTAY and Maréchal† have introduced a valuable modification into practice, as they require no steam-boiler for the manufacture of the water-gas, and

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† *Bull Soc Chim.*, 1868, i., 334.

thus economise fuel, whilst the wear of the simplified apparatus is considerably reduced. They heat coal with soda, hydrate of lime or of baryta in iron retorts, and thus decompose the combined water of these bases, which is then freed from carbonic acid in the ordinary manner. This procedure has been adopted by the New York Oxygen Company, who, in the manner described above, sell water-gas at the enormous price of 2 cents per cubic foot, or 1 cubic metre for 3s. 6d.* The mixture of lime and anthracite is heated in retorts such as those described above under Tessié du Motay's method of preparing oxygen. The decomposition takes place at a red-heat, according to the equation—



and lasts about fifteen minutes. Thereupon hydrate of lime is re-formed by passing steam over the heated mass. The carbon is not exhausted until after three weeks, and is then replaced by a fresh supply of anthracite.

That coal-gas contains large quantities (30 to 50 per cent) of free hydrogen, and that the proportion of this ingredient rises, the higher the temperature of the retorts in preparing the gas, has long been known. Tessié du Motay and Maréchal, whilst introducing the above-described procedure, have taken advantage of this circumstance, and have passed coal-gas over lime in order to resolve it into carbon, hydrocarbons boiling at high temperatures, and large quantities of hydrogen. At the same time E. Vial† adopted the same method, and has doubled, and even trebled, the yield of gas by "decarburation." Schinz‡ doubts the industrial value of this process, on account of the outlay for fuel, and calculates that the decomposition of water by means of coal yields a luminous gas for half the cost of coal-gas. Here, however, as we shall presently see, the depreciation of the plant has not been taken into account.

If we now enquire in what manner the hydrogen, however obtained, is rendered luminous, we find two essentially different methods. The one depends on mixing the water-gas with hydrocarbons. As early as 1834|| Selligie employed, at Paris, the oils obtained by distilling the marl-shales of Autun in order to saturate the water-gas with gaseous hydrocarbons. White subsequently passed the water-gas through retorts in which rosin or coal was converted into luminous gas, and his process was carefully examined in 1851 by Frankland,§ who concludes a laudatory report with certain propositions, of which the following are the most important:—

1. The production of gas from given weights of common coal or of cannel is increased by 46 to 290 per cent, according to the quality of the material employed.
2. The luminous power is increased by 12 to 108 per cent, the more when coals are employed which produce gas of a highly luminous power.
3. The quality of the residual tar is lowered, a part of it being converted into gas of a strong luminous power.

It must be remarked that tar had not at that time the value which it has subsequently reached.

White's process recurs, with trifling modifications, under a variety of names.

The Royal Polytechnic.—A new lecture entitled "Flames and Flares" and their characteristics has just been introduced at the above Institution by Professor Gardner. The lecture is illustrated with some interesting experiments.

* H. Vogel, *Ber. Chem. Ges.*, iii., 901.

† Vial, *Genie Industriel*, 1869. *Dingl. Pol. J.*, cii., 382.

‡ Schinz, *Dingl. Pol. J.*, cii., 388.

|| Dumas, "Handbuch der Chemie," vil.

§ Frankland, *Ann. Chem. Pharm.*, lxxxii., 48.

REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from page 172.)

"Reduced" Phosphates.

Of all the chemists who have communicated with the Committee, only two consider that the so-called "reduced" phosphates can be estimated even approximately by any known method. One of these writes as follows:—"I employ a process based on the ready decomposition of gelatinous phosphate of lime by oxalate of ammonia, and the almost complete inaction on the mineral phosphate by the same salt. Although not an exact process, it gives good approximate results within half a per cent; and seeing the urgent need for some such means of estimation, more especially in the case of bone-manures, in which a large proportion of decomposed phosphate may exist unrecognisable by the ordinary soluble phosphate determination, I think it better to employ even an imperfect process than to classify such decomposed phosphate with undecomposed mineral phosphate."

Professor A. H. Church, referring to the bicarbonate of sodium method, described on page 146 of his "Laboratory Guide"† (3rd edition), writes:—"It is the only method giving approximate results."

A series of highly instructive experiments on the estimation of "reduced" phosphates has been contributed by Mr. M. J. Lansdell. With the oxalate of ammonium method of Mr. A. Sibson,‡ and with the bicarbonate method (which was first described by Mr. Chesshire§), Mr. Lansdell obtained the following results—the samples being all passed through the same sieve, and the proportions employed being the same as those recommended by the authors:—

| | Sample Contained. Equal to $\text{Ca}_3\text{P}_2\text{O}_8$. Per cent. | Dissolved. | |
|---------------------------|---|--|----------------------------------|
| | | Equal to $\text{Ca}_3\text{P}_2\text{O}_8$. Sibson's Method. | Chesshire's Method. Per cent. |
| Cambridge coprolite.. .. | 56.07 | 8.32 | 2.23 |
| Bone-ash | 76.87 | 10.58 | 3.07 |
| Navassa phosphate | 65.62 | 7.48 | 5.73 |
| German phosphate | 60.74 | 8.04 | 2.09 |
| Redonda phosphate (dried) | 87.42 | 19.72 | 56.97 |
| " " (lump) | 86.58 | 19.10 | 64.65 |

By employing a solution of bicarbonate of twice the above strength the Redonda phosphate gave P_2O_5 equal to 84.3 of $\text{Ca}_3\text{P}_2\text{O}_8$ in solution. Using a smaller quantity of the sample in the oxalate method, 47.76 per cent passed into solution.

The above results show that neither method is at all satisfactory, and Mr. John Hughes|| has made experiments leading to the same conclusions.

Another correspondent writes:—"There is no reliable process known for the estimation of 'reduced phosphates' under all circumstances. Even the citrate of ammonium method, which seems to be the one generally preferred, utterly fails to distinguish between 'reduced phosphates' and the native phosphate of aluminium, known as

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

† This process consists in boiling the insoluble portion of 5 grms. of the sample for one hour with a solution of 10 grms. of sodium bicarbonate in 300 c.c. of water, filtering hot, acidifying, concentrating, precipitating with magnesia, &c.

‡ CHEMICAL NEWS, vol. xx., p. 123.

§ *Ibid.*, vol. xx., p. 111.

|| *Ibid.*, vol. xix., p. 266.

'Redonda phosphate,' the latter being largely soluble in the citrate of ammonium solution; so that the latter, which is a comparatively cheap material, if introduced into a superphosphate, would, according to the results obtained by the methods usually employed for estimating reduced phosphates, be quoted as the latter."

Mr. T. L. Patterson has criticised the citrate of ammonium method in a paper contributed to the CHEMICAL NEWS (vol., xxv., pp. 255 and 268).

Mr. W. Galbraith makes the following remarks on the estimation of "reduced phosphates":—"It seems to me that an arbitrary method of determining these phosphates would serve every purpose; that is, provided there is a necessity for determining them (from a commercial point of view), which I am inclined to dispute; because any other phosphate in as fine a state of division as these 'reduced phosphates' is of equal value, and if (as some chemists maintain) these 'reduced phosphates' consist principally of phosphates of iron and aluminium, they cannot, and should not, be reported or assumed to be phosphate of calcium. It is well known that the presence of oxides of iron and aluminium is the cause of the manure 'going back.' Superphosphates containing no iron or aluminium do not 'go back,' so that the manufacturer has the remedy in his own hands—to avoid using mineral phosphates containing iron and aluminium. At present a manufacturer who makes his manure from a phosphate containing iron and aluminium, and who sells it immediately after manufacture, has a decided advantage over another manufacturer who has made his manure from a phosphate containing no iron and aluminium, because a mineral phosphate containing iron and aluminium is much cheaper than one free from these substances. Besides, the iron and aluminium are almost invariably stated in the analysis of a mineral phosphate, while these substances are seldom, if ever, mentioned in the analysis of a superphosphate. I do not think it advisable, even if possible, to determine the *actual* amount of 'reduced phosphate,' but an arbitrary method, or a method of determining phosphate of given fineness which would include 'precipitated phosphate' would, I think, be very serviceable, and such a process could be easily devised."

Statement of the Commercial and Agricultural Value of Manures.

Without exception, all the chemists who reply to this question are of opinion that it is highly undesirable that analysts should express any opinion on the commercial value of a manure. Many of them are of opinion that tricalcic phosphate, for instance, has a very different value according to its origin and state of division, and that any valuation of a manure not taking this and similar facts into account must be worse than useless. Most of the chemists who have replied consider that phosphates of iron and aluminium have an exceedingly limited manurial value. The *relative* manurial value attributed to phosphoric acid existant in different states is very differently regarded, and as many of the opinions expressed appear to be based on very insufficient evidence, the Committee think it unnecessary to quote the various replies received.

Mode of Occurrence of the Constituents of Manufactured Manures, and Statement of the Results of Analysis.

On this subject the Committee has received a large amount of valuable, but somewhat discordant, evidence. Very strong opinions are expressed to the effect that the quantity of iron and aluminium present in a manufactured manure (superphosphate) should always be stated. Such a plan would enable the manufacturer or purchaser to judge of the probability of a newly made manure "going back" on keeping, and would enable a more accurate opinion to be formed of its true value than is possible while the presence of iron and aluminium is ignored. At the same time, the estimation of the "reduced phosphates" would often be rendered superfluous.

With respect to the mode of occurrence of the consti-

tuents of manufactured manures, the Committee considers the evidence before it too vague and conflicting to justify any expression of opinion at present.

(To be continued).

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.*

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 177).

Section 2.—Lixiviating the Black-ash.

When the black-ash is made it is allowed to stand on the ball bank until required for use; this time depends upon the stock of balls kept in hand, and may vary from a day to a week. When required, the balls are broken in pieces (each ball into nine or ten pieces) and placed in vats usually about 9 ft. square, and varying in depth from 4 to 6 ft. according to circumstances. These vats are usually worked in sets of four, though there are places where they are worked in sets of three, of five, and one, at least where they work in a set of eight. The vats are worked in connection with each other; water at temperatures varying from 90° F. to 150° F., running on to the weakest vat, and liquor at 53° T., at 120° to 140° F., running off the newly filled or strong one. When the weak vat has been run down to 3° to 4° T. warm water is run on to it, the resulting liquor being run off into what is called the weak liquor well. It usually possesses a sp. gr. equal to 1° to 2° T., and the following analysis may serve to show its composition:—

| 1° T. = sp. gr. 1.005 | | | | |
|------------------------|-------|--|--|--|
| Sodium hydrate | 2.640 | | | |
| „ carbonate | 1.060 | | | |
| „ sulphide | 2.690 | | | |
| „ hyposulphite | 0.554 | | | |
| „ sulphate | 0.284 | | | |
| „ chloride | 6.780 | | | |
| „ silicate | 0.100 | | | |
| „ aluminate | 0.108 | | | |

Total solids per litre 14.216

This liquor is used before water for the next vat, and only when this supply is exhausted is fresh water used, so that there should be in properly arranged vats but very little loss of soluble alkali.

The strong vat generally starts running off at 54° T., at 130° F., and in some caustic works is kept at such a strength that the resulting liquors will stand about 50° T., at 110° F.; in this case it will contain the minimum of sodium sulphide. Others run the liquors so that they will stand 36° T., or at all strengths between these two extremes.

Kolb has shown the principal points to be watched in the lixiviation of black-ash; they may be enumerated thus:—1. Rapid lixiviation. 2. The avoidance of high temperatures. 3. The employment of as little water as possible. He also states that the quantity of water used is without influence on the causticity of the liquors, but the amount of sulphides increase with the quantity of water. The proportion of sodium sulphide to the quantity of alkali in solution does not increase much until the liquors are run below 40° T.; there is an increase, but not a considerable one, and the proportion of caustic alkali to the carbonate I have always found to be a constant number for all strengths above 10° T. in the same vat.

After leaving the vats the liquor is generally run into settlers, where sulphide of calcium is deposited, together with some sulphide of iron, and a large quantity of the insoluble double silicate of alumina and soda, formed by

* From the *Journal of the Society for the Promotion of Scientific Industry.*

the mutual reaction of the silicate and aluminate of soda upon each other.

The following (A) is an analysis of the deposit from a settler, after being carefully washed and dried in a current of hydrogen, and by its side (B) may be seen an analysis of the double silicate of aluminate and soda, which forms a crust upon concentrating pans, making caustic ash, and also falls to a large extent in the settlers:—

| | A. | B. |
|--------------------------|-------|--------|
| Silica | 23.60 | 39.572 |
| Alumina | 18.44 | 33.584 |
| Sodium oxide | 13.12 | 20.776 |
| Water | — | 5.844 |
| Iron sulphide | 5.84 | — |
| Calcium sulphide | 38.00 | — |
| | <hr/> | <hr/> |
| | 99.00 | 99.776 |

The black-ash originally and before lixiviation probably contains cyanide and sulphocyanide of sodium, together with iron peroxide. This last is transformed into iron sulphide in the vats, which becomes the means of changing the cyanide of sodium into ferrocyanide. This ferrocyanide exists in black-ash liquors, in very varying quantity, often containing none, whilst at other times they are highly charged with it. If the iron sulphide is not in sufficient quantity to convert all the cyanide, or if a sufficient temperature has not been reached in the vats, the cyanide is decomposed during the ebullition of the liquors on concentration, ammonia being evolved, and sodium formiate remaning in the solution.

The hyposulphite is without doubt formed by the oxidation of the sulphide, and there is great probability that the oxide of iron present has something to do with this oxidation.

Other constituents are present in small quantity, and to conclude this section I give two analyses of vat liquors, the results being expressed in grammes per litre:—

| | 50° T. at 90° F. | 50½° T. at 90° F. |
|-------------------------|---------------------|----------------------|
| Iron sulphide | 0.074 | 0.042 |
| Sodium sulphide | 4.485 | 3.822 |
| „ sulphite | 1.323 | 0.979 |
| „ hyposulphite | 1.580 | 1.774 |
| „ sulphate | 12.707 | 14.258 |
| „ chloride | 19.597 | 23.412 |
| „ silicate | 5.961 | 3.774 |
| „ aluminate | 3.371 | 4.218 |
| „ ferrocyanide | 0.133 | 0.416 |
| „ sulphocyanide | 0.211 | 0.196 |
| „ phosphate | traces | traces |
| „ fluoride | traces | traces |
| „ carbonate | 209.500 | 204.326 |
| „ hydrate | 44.800 | 52.740 |

Total solids per litre 313.742 320.857

Traces of the following oxides also exist in solution:—calcium oxide, manganese oxide, and magnesium oxide.

The vat liquors should be chemically examined morning and evening, and the results may be arranged in the following form:—

| Date. | Deg. T. | Deg. F. | Total alkali. | Caustic alkali. | Na ₂ S. |
|---------|---------|---------|---------------|-----------------|--------------------|
| June 17 | 52° | 140° | 184.0 | 63.8 | 5.62 |
| July 14 | 53° | 124° | 190.6 | 68.4 | 4.96 |

The above are expressed in grammes per litre.

Section 3.—Causticising.

The settled vat liquor is now diluted with water and heated to boiling, and manufacturers are not of one opinion as to what should be the extent of this dilution. Some works causticise at 15° T., while a few prefer 20° T., all other works preferring a gravity of their own, ranging between these two extremes. Quicklime is then added, and the whole steamed and agitated until the “operation” is thoroughly causticised. The extent of this causticisa-

tion is generally left to the workman, who takes out a sample and allows it to settle; the clear liquor being poured into a test-tube should show no effervescence when treated with an excess of any dilute acid; but I would insist upon the strict watch being kept over this process as I have in the two previous sections.

The operations are usually causticised in pans of no definite size, old boilers cut in halves being frequently employed, and there exist two distinct methods of agitation; one, in which the agitation is produced by the injection of air, in the other mode it is produced by mechanical arrangements.

The first method possesses the advantage that while the liquor is being agitated the sulphides are being oxides; in the mechanical method no oxidation of the sulphides can take place.

The carbonate of lime which settles in the pan is generally removed after every second operation. After the operation has been allowed to settle the clear liquor is run off, and another batch of diluted liquor run upon it; more lime is added, and this second batch is causticised, and, after settling, the clear liquor is run off. Water is then generally added to the mud, which is agitated and steamed, after which the carbonate of lime is allowed to settle, and the clear liquor which is run off is used for diluting the next batch of liquor. The mud which remains is now plunged up with a little water and run on to the filters, where it is allowed to drain, either by itself, or by the aid of a vacuum pump; it is then washed once or twice upon the filters with water, and afterwards wheeled away to the mixing of the black-ash.

The following are two analyses of lime mud from the filters, just as going in to the black-ash mixing:—

| | A. | B. |
|---------------------------------|--------|--------|
| Calcium hydrate | 2.825 | 2.652 |
| Sodium „ | 1.906 | 1.663 |
| „ chloride and sulphate | 0.244 | 0.206 |
| Calcium carbonate | 40.170 | 42.031 |
| „ hydrate | 3.756 | 3.072 |
| Silica | 0.673 | 0.774 |
| Alumina | 0.255 | 0.324 |
| Iron peroxide | 0.048 | 0.708 |
| Magnesia | 0.086 | 0.095 |
| Soda | 1.832 | 1.600 |
| Water | 47.986 | 46.577 |
| | <hr/> | <hr/> |
| | 99.781 | 99.702 |

The first three bracketed were soluble when 5 grms. of the mud were digested in 100 c.c. water at 100° C.

I will now lay before you two analyses, of which A is of vat liquors simply diluted with water and before causticising, and B is the same liquor after causticising, the agitation of the operation being produced by means of the injection of air.

| | A. | B. |
|-------------------------|--------|----------------------------------|
| Iron sulphide | traces | { traces |
| Sodium „ | 1.068 | { Fe ₂ O ₃ |
| „ sulphite | 0.151 | 0.264 |
| „ hyposulphite | 1.137 | 1.864 |
| „ sulphate | 5.423 | 5.006 |
| „ chloride | 8.576 | 7.995 |
| „ silicate | 0.852 | 0.176 |
| „ aluminate | 2.490 | 1.438 |
| „ carbonate | 53.167 | 2.954 |
| „ hydrate | 44.280 | 74.000 |
| „ ferrocyanide | 0.093 | 0.086 |
| „ sulphocyanide | 0.054 | 0.050 |
| „ phosphate | traces | traces |
| Insoluble | 0.849 | none |

Total solids per litre.. .. 118.140 93.833

There were also traces of lime, magnesia, and manganese oxide in the solutions.

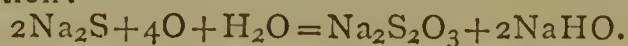
A had a gravity of 20° T. at 56° F., and B possessed a gravity of 18° T. at the same temperature.

The next sample is from a works where it was preferred to causticise at 15° T., and the agitation of the operation was performed mechanically. When finished the gravity was 13° T. at 52° F. The ferrocyanide, sulphocyanide, and other like constituents were not estimated:—

| | |
|--------------------------|--------|
| Iron sulphide | traces |
| Sodium | 1.092 |
| „ hyposulphite | 1.264 |
| „ sulphite | trace |
| „ sulphate | 3.264 |
| „ chloride | 4.212 |
| „ silicate | 0.151 |
| „ aluminate | 0.584 |
| „ carbonate | 7.844 |
| „ hydrate | 50.400 |
| Other constituents | 0.200 |

Total solids per litre.. .. 69.011

Now, in the agitation by injection of air as in analysis B, it will be seen that the sulphide has been completely oxidised. The first stage in the oxidation is the formation of hyposulphite and sodium hydrate, after the following equation:—



Upon continued blowing in presence of alkali, I am informed by an experienced chemist in the alkali trade that sulphate is the ultimate product. I cannot confirm this by direct experiment, but the analyses given above show that although some sulphate and sulphite was produced, yet during the time the operation was blown very little but hyposulphite was formed.

I have mentioned in previous part of this paper that the use of the various metallic oxides has been patented from time to time for the purpose of eliminating the sulphides from the alkaline liquors. The oxides of iron, zinc, and manganese have often been tried by experimenters, but they have all been abandoned, and even the zinc oxide, which seemed to promise so much, has been found not to work well in practice; the zinc sulphide which is produced is a slimy precipitate which does not settle well in the alkaline liquor.

The only oxide which is practically useful is that of lead, and litharge has been used in at least two works with much success, but care is required in its use, or it becomes a serious item in the cost of production.

When litharge is used it is sometimes put into the causticising pan in small quantities at a time until the settled liquor shows but a slightly black colour with a solution of lead acetate. With fair liquor in practice the litharge used will amount to rather less than 50 lbs. per ton of 60 per cent caustic, and the nitrate of soda used in finishing is reduced thereby to less than 6 lbs. per ton of caustic. The litharge being very heavy renders it necessary to agitate the operation very energetically, and the agitation should be performed mechanically, no oxidation by any means being allowed, as when the sulphide is decomposed by litharge an equivalent of alkali is liberated; but when oxidised it eventually becomes sulphite, which if skimmed off the pots is only of the value of salt cake, and if it remains in the caustic is only of the same value as salt.

Probably the best way of using the litharge is to previously dissolve it in some strong caustic liquor of 50° T.; a great deal will remain at the bottom undissolved, and the clear liquor only is run into the causticiser until the decomposition of the sulphide is effected. By this means no litharge is wasted, fresh caustic liquor of 50° T. being applied to the undissolved litharge for effecting its solution.

The sulphide of lead which is formed settles very readily and remains mixed with the lime mud; but this in no way interferes with its use in the black-ash mixing.

Now, as to the dilution of liquors. Some manufacturers causticise at 14° T., because they say that at a higher gravity the carbonate of soda is not decomposed, while others say that although it is decomposed, yet it takes a longer time at a higher gravity.

I have satisfied myself that these statements have no foundation in fact, and that causticising at 20° T. is as easy as at 15° T., and takes no longer proportionate time. In the analysis B causticised liquor there are 74.0 grms. of sodium hydrate in the litre, and 97 per cent of the alkali has been causticised; in the second sample at 13° T. there are only 50.4 grms. per litre, and only 90 per cent of the alkali has been causticised. To look at it in another light, in the second sample nearly half again as much water has to be evaporated than in the first operation; the ratio of water to solids is 14.6 to 1 in the last sample, and only 10.6 to 1 in the first.

These operations are too often left entirely to workmen or working foremen, who perhaps forget that it *pays* to spend half as long again over an operation, or to use half again as much lime if there is one and a-half times the quantity of alkali in one batch, or, what amounts to the same thing, less water to evaporate, in this case amounting to no less than 4 tons for every ton of 60 per cent caustic.

Before leaving this section I wish to point out that most of the silica existing in the vat liquors as sodium silicate is eliminated in the causticiser; according to the analyses A and B of the liquor before and after causticisation, about 80 per cent of the silicate of soda has been decomposed, and in the analyses another salt of soda, viz., the aluminate, stands out very prominent.

The presence of the aluminate of soda is caused by the introduction of the solution of caustic bottoms. These bottoms are dissolved in water to between 20° T. and 30° T., and the clear solution is run into the operation pan with the diluted vat liquor.

Now, on adding lime to the operation an insoluble aluminate of lime is formed, and the analyses show that about 42 per cent of the aluminate of soda has been converted.

There has been much talk about re-converting this lime mud again into lime and using it continuously; but it must be remembered that in any process where impurities or any foreign matters of any kind creep in, there must be some outlet for them, and when we consider what a very small margin there is for working expenses in driving off the water and the carbonic acid, it seems very apparent that it never will be used continuously so long as it can be used up in the black-ash mixing for its equivalent of limestone.

Its conversion to lime has been tried in several works, especially soaperies, but has always been abandoned owing to the cost attending the operations.

To put it into a practical form. 1 ton of lime does its work in the causticiser, and produces 1.75 tons of carbonate of lime, making the cost of this carbonate 10s. 9½d. per ton, as against 7s., for which it can be purchased at the present time. Some, perhaps, would wish the soda to be calculated in; but there is no doubt that the major portion of this constituent is recovered in the black-ash, and enters the process again.

Taking things as they stand. Offer a lime burner, lime mud at 4s. 6½d. per ton of CaCO_3 , and limestone at 7s., a practical man could not be at a loss to know which he would choose.

To conclude this section, I would again insist upon chemical supervision, and instead of leaving the operation entirely to the workman, a sample of the batch should be obtained when the operation is near completion, and the steam should not be turned off until the chemist in charge of the process has declared at least 94 per cent of the alkali to be causticised.

The results may be kept in a book in this form:—

| Date. | No. of Batch. | Steam put on. | °Tw. | Total Na ₂ O. | Caustic Na ₂ O. | P.c. Causticised. | Stm. off. | °Tw. |
|-------|---------------|---------------|------|--------------------------|----------------------------|-------------------|-----------|---------------|
| | 824 | 8.0 a.m. | 14½° | 43.64 | 39.06 | 90.0 | 1.09 | 11.0 a.m. 13° |
| | 825 | 1.0 p.m. | 20° | 59.07 | 57.35 | 97.0 | none | 5.0 p.m. 18° |

The liquor is now to be settled well until it is clear and bright, and on no account should it be run into the pans before it is in this condition.

(To be continued)

SOCIETY OF PUBLIC ANALYSTS.

ON TEA.*

By G. W. WIGNER.

(Continued from page 168.)

By considering together the forty samples of ordinary teas, and twenty-seven of special teas, we obtain a series of figures which may be taken to represent the limits of variation in genuine teas as imported.

Average of Sixty-seven Samples.

| | Total Ash. Per cent. | Ash Soluble in Water. Per cent. | Ash Soluble in Acid. Per cent. | Silica. | Potash. |
|---------|-------------------------|---------------------------------------|--------------------------------------|---------|---------|
| Average | 5.78 | 3.15 | 2.17 | 0.46 | 1.45 |
| Maximum | 7.02 | 3.88 | 2.87 | 1.67 | 1.96 |
| Minimum | 5.17 | 2.64 | 1.33 | 0.04 | 1.08 |

The average results expressed in percentages of the total ash are—

| | |
|---|----------------|
| Soluble in aqua | 54.50 per cent |
| (Containing alkali calculated as potash 25.09) | |
| Soluble in acid | 37.54 .. |
| Silica | 7.96 .. |
| | 100.00 |

while the maximum percentage of soluble ash calculated in the same way is 70.60, and occurs in a very high-priced sample of Oolong (53) and the minimum 38.33, which occurs in a very inferior sample of caper (74), though I believe, from a most careful examination, it was really genuine. If, however, the extraneous siliceous matter present in the sample is deducted, the proportion of soluble ash will be 45.86 per cent. The nearest approach to this figure is another caper (81) which gives 46.64 per cent soluble ash, and it is only in rare cases that a sample of any other tea but caper contains less than 50 per cent of ash soluble in water, and there is only one case in which the ash soluble in water falls below the ash soluble in acid, the figures then being 2.75 and 2.87 per cent.

If, instead of considering these samples in their ordinary state, the results are calculated to the dried teas, we get figures which are in some respects more nearly constant.

Thus the seventeen ordinary teas, after drying, give the following results:—

| | Total Ash. Per cent. | Ash Soluble in Water. | Ash Soluble in Acid. | Silica. | Potash. |
|---------|-------------------------|--------------------------|-------------------------|---------|---------|
| Average | 6.25 | 3.34 | 2.43 | 0.48 | 1.50 |
| Maximum | 6.48 | 3.68 | 3.07 | 0.82 | 2.07 |
| Minimum | 5.98 | 2.94 | 2.15 | 0.16 | 1.26 |

And the eighteen special teas—

| | | | | | |
|---------|------|------|------|------|------|
| Average | 6.23 | 3.74 | 2.14 | 0.35 | 1.67 |
| Maximum | 7.42 | 4.16 | 2.91 | 0.93 | 2.11 |
| Minimum | 5.57 | 3.15 | 1.43 | 0.04 | 1.42 |

And the nine capers—

| | | | | | |
|---------|------|------|------|------|------|
| Average | 6.61 | 3.48 | 2.02 | 1.11 | 1.40 |
| Maximum | 7.33 | 3.84 | 2.05 | 1.46 | 1.42 |
| Minimum | 6.15 | 3.21 | 2.00 | 0.93 | 1.38 |

And again putting the whole of the sixty-seven samples together, after drying—

| | | | | | |
|---------|------|------|------|------|------|
| Average | 6.33 | 3.45 | 2.38 | 0.50 | 1.54 |
| Maximum | 7.42 | 4.16 | 3.07 | 1.76 | 2.11 |
| Minimum | 5.57 | 2.94 | 1.43 | 0.04 | 1.26 |

* Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

In the original teas the variation in total ash amounts to 32 per cent of the average, but in the dried teas it is only 29.3 per cent, while the variations in alkali in the original teas are 63.5 per cent of the average, and in the dried teas only 55 per cent.

Having thus carefully considered all the principal species of teas as imported, we will pass to retailers' samples. It is, of course, an uncommon thing to buy an unmixed sample of tea at a shop. The true art of the tea dealer consists in this blending of teas, and there can be no doubt that the consumer gains by it. It is, however, inevitable that in this mixing a small amount of dust and dirt should be introduced, and the proportion to which this occurs may be fairly estimated from the following figures, which are the average, &c., of thirty-three retailers' samples. These include almost every price and quality of tea:—

| | Total Ash. Per cent. | Ash Soluble in Water. | Ash Soluble in Acid. | Silica. | Potash. |
|---------|-------------------------|--------------------------|-------------------------|---------|---------|
| Average | 6.39 | 3.29 | 2.39 | 0.71 | 1.30 |
| Maximum | 7.25 | 3.91 | 3.35 | 1.45 | 1.78 |
| Minimum | 5.15 | 2.71 | 1.38 | 0.20 | 0.94 |

Or if the results are calculated to the dried tea—

| | | | | | |
|---------|------|------|------|------|------|
| Average | 6.74 | 3.58 | 2.52 | 0.69 | 1.48 |
| Maximum | 7.79 | 4.22 | 3.68 | 1.56 | 1.98 |
| Minimum | 5.69 | 3.11 | 1.63 | 0.22 | 1.06 |

These results show about $\frac{1}{2}$ per cent of extraneous matter, *i.e.* dirt added in the mixing process, which is probably quite as little as could be reasonably expected. The average percentage of soluble ash remains almost the same, and the percentage of alkali is slightly less.

Passing from the ash to the extractive matter, I find it is by no means a matter of indifference in what way this is determined. The proportion of soluble matter yielded by tea differs very greatly according to whether the tea is powdered or in whole leaf, and also according to the amount of water used and the number of extractions to which the sample has been submitted. The most accurate method would appear to be to powder the leaves, and then boil them repeatedly, filtering each time until no more soluble matter can be extracted; but in practice this process proves to be almost interminable, and it may be from this cause that the results sometimes announced in disputed cases have been so discordant. Samples which have been powdered and boiled four times in succession with 100 times their weight of water each time, and carefully washed on the filter, still yield more soluble matter on re-boiling. I prefer, therefore, for reasons which I will give, to adopt a different method.

Powdered tea almost invariably yields more extract than whole leaf tea, but the excess is variable; in some cases it is only 1 per cent, and in others as much as 5 or 6 per cent. I cannot, however, discover any rule or apparent regularity in this variation. It is easy to obtain uniform results from the powdered samples, but impracticable to do so from whole leaf; I have, therefore, always adopted the rule of powdering.

I have made many experiments to determine the relative proportions of soluble matter yielded when tea is treated in different ways; and the following, which were made on an average sample of some 60 pure black teas, give results which serve as a very fair guide. Each sample was boiled for an hour under a vertical condenser, cooled and filtered, and the extract evaporated.

| | Per cent. |
|--|-------------------|
| 1 part of tea in 200 parts of water yielded | 34.10 of extract. |
| " " 100 " " " | 30.55 " |
| " " 50 " " " | 27.55 " |
| " " 20 " " " | 22.96 " |
| Exhausted leaves from do. boiled a second time (additional) | 8.17 " |
| Do. boiled a third time (additional) | 3.75 " |
| " " fourth " " | 1.79 " |
| Total of four boilings of 1 part of tea in 20 parts of water | 36.67 " |

And even in the last case the tea was not exhausted, for on making fresh experiments I found that 10 grs. of the same sample boiled four times in 3500 grs. of water, each time yielded altogether 39.70 per cent of extract, while 50 grs. boiled four times in the same quantity of water yielded only 35.10 per cent of extract. Other experiments on different samples have confirmed the general character of these figures, though the details differ a little. On considering these facts, I concluded that the most reliable method was to make the 1 per cent infusion, because the results appeared rather more uniform, and there was obviously far less chance of error than when the same sample has to be boiled four or five times. I have therefore adopted it in all the following analyses.

The ash of the extract is generally heavy; in some cases it approaches very nearly to the ash of the original tea, and in exceptional cases even exceeds it. I shall have to speak further on this point when I consider the actual composition of the ash of tea and tea-extract.

The following table shows the amount of extract yielded by twenty-four genuine teas. They are divided into three classes, and arranged in each class according to the percentage of extract yielded:—

EXTRACTS OF TEAS.

Ordinary Teas (Genuine).

| No. | Description. | Extract. | Ash of Extract. |
|-----|-------------------|----------|-----------------|
| 49. | Gunpowder | 39.20 | 5.75 |
| 51. | Hyson | 36.80 | 5.00 |
| 52. | Congou | 33.00 | 4.75 |
| 41. | " | 29.80 | — |
| 48. | " | 29.80 | 4.45 |
| 43. | " | 26.20 | 4.60 |
| 47. | " | 26.15 | — |

Special Teas (Genuine).

| | | | |
|-----|-------------------------|-------|------|
| 2. | Moyune young Hyson .. | 44.85 | 7.00 |
| 1. | Indian | 43.85 | 5.80 |
| 11. | Broken Indian | 43.43 | 6.13 |
| 4. | Moyune Gunpowder .. | 40.75 | 5.45 |
| 54. | Oolong | 40.75 | — |
| 57. | Moyune Gunpowder .. | 39.30 | 4.80 |
| 6. | " | 38.50 | 4.90 |
| 5. | " | 37.95 | 5.25 |
| 10. | Manuna (fine) | 37.00 | 6.00 |
| 17. | Scented Orange Pekoe .. | 34.20 | 5.40 |
| 7. | Moyune Gunpowder .. | 33.35 | 4.05 |
| 55. | Assam | 33.30 | 6.60 |
| 21. | Indian Souchong | 32.50 | 5.50 |

Capers (Genuine).

| | | | |
|-----|---------------|-------|------|
| 78. | Caper | 37.90 | 4.70 |
| 80. | " | 37.75 | 5.15 |
| 81. | " | 32.40 | 5.25 |
| 79. | " | 30.05 | 4.70 |

The average of all these results is—extract, 35.79 per cent; ash of extract, 4.63 per cent; while the maximum and minimum extract are 44.85 per cent and 26.15 per cent respectively, or a variation of 52 per cent calculated on the average, and the maximum and minimum ash are 7.00 per cent, and 4.05 per cent respectively, or a variation of nearly 64 per cent calculated on the average.

In ordinary cases of tea analysis I think these determinations of extract are of little value, but they appear to be of use in two special cases. When teas are adulterated with exhausted leaves, the extract will certainly be reduced; thus I found one sample of tea recovered from a sunken vessel yielded only 20.40 per cent of extract, of which 3.08 per cent was chloride of sodium, leaving only 17.32 per cent of nett extract; and another sample of a similar character yielded only 23.29 per cent of extract, of which 1.11 per cent was chloride of sodium, leaving 22.18 per cent nett extract. In both these cases, however, the examination of the ash had already clearly revealed the fact of the tea being partly exhausted.

In some other cases it may be desirable to estimate chemically the value of a sample of tea, and the determination of extractive matter is certainly of service in this case. By careful consideration of the soluble ash—alkali in ash and extractive matter—a tea may be valued almost as closely as by an experienced tea taster. The tables which I have given will illustrate this fact.

The weight of the ash of exhausted leaves is very variable. It averages about 2.50 per cent when the extract has been made on the 1 per cent system, which I recommend, but it is not at all uncommon to find as much as 3.5, or as little as 2 per cent. As a means of judging of the purity of tea, this determination is almost valueless.

(To be continued.)

REGULATIONS FOR INSPECTORS, &c., UNDER THE SALE OF FOOD AND DRUGS ACT.

THE following regulations, the first which have come under our notice, have been adopted by the Plumstead District Board of Works, and we reprint them, as it is possible they may serve as a guide to some appointing bodies who have not yet framed any bye-laws of their own:—

PLUMSTEAD DISTRICT BOARD OF WORKS.

"SALE OF FOOD AND DRUGS ACT, 1875."

Regulations to be observed by Purchasers and Inspectors.

1.—The Inspectors of Weights and Measures are the persons appointed by the Board to procure samples of food and drugs, and to submit them to the Analyst.

2.—The Analyst appointed by the Board is G. W. Wigner, Esq., F.C.S., 79, Great Tower Street, London, E.C.

3.—Any purchaser of any article of food or of any drug in this district shall be entitled to take the same to the Analyst, and on payment to him of the sum of 10s. 6d., and on signing a Declaration in accordance with the form appended hereto, to have the same analysed, and to receive from the Analyst a certificate of the result of his analysis.

4.—Every person purchasing an article for the purpose of having the same analysed shall, after the purchase shall have been completed, notify to the vendor his intention to have the article analysed, and shall offer to divide it into three parts, and (unless the vendor declines his offer) he shall there and then divide the article into three parts, each part of which he shall securely cork in a bottle, seal, and label with the name of the purchaser, the date of purchase, and the name of the vendor. The purchaser shall hand one part back to the vendor, retain one part himself, and take the remaining part to the Analyst.

5.—It will be the duty of the Inspectors to procure samples of food and of drugs, the purity of which the Board, the Analyst, or the Inspector may have reason to suspect, under the direction of the Analyst, and to submit them to the latter officer for analysis. The Analyst will send his certificate to the Board, at their office, at Charlton, when they will consider the same, and, if they think fit, direct legal proceedings to be taken against the seller of the sample, under the provisions of this Act.

6.—An inspector must, after buying and paying for a sample, immediately notify to the person supplying him his intention to take the same to the Public Analyst, for the purpose of having it analysed, and shall offer to divide the sample into three parts, and, if the vendor wishes him to do so, shall divide the sample into three parts, each part of which he will securely cork up in a bottle and seal with his own seal, in such a manner as to render it impossible for the contents of the bottle to be tampered with without the seal being broken. He will then hand one part to the vendor, take another part to the Analyst, and retain the third part himself.

7.—If the vendor does *not* desire to have the sample divided into three parts, the inspector shall take the sample intact to the Analyst, in whose presence it shall be divided, the inspector retaining one part.

8.—As any vendor refusing to supply an inspector with a reasonable portion of any article of food or of any drug which is on sale by retail, on the proper amount of purchase-money being tendered to him, is liable to a fine of £10, the inspector must, in every case of such refusal, at once report full particulars to the Clerk of the Board.

9.—Each inspector shall keep particulars of all samples purchased, and shall number them consecutively, but the name of the vendor shall not be communicated to the Analyst, whose certificate shall only refer to the sample by its consecutive number or distinguishing mark.

Form of Declaration to be signed by the Purchaser of any Article of Food or of any Drug on his submitting it to the Public Analyst for the purpose of having it Analysed.

"SALE OF FOOD AND DRUGS ACT, 1875."

I, the undersigned,..... of declare that on the.....day of.....I purchased the sample of.....which I now hand to G. W. Wigner, Esq., Public Analyst for the Plumstead District, from.....under the name of....., and that I duly informed the vendor of my intention to submit the same for analysis to the above-named Public Analyst, and that in the presence of the said vendor I offered to divide the article purchased into three parts, which offer he did (not) accept, and that I duly sealed and secured the three parts and handed one of the same back to the vendor or his agent, that I desire to have the part which I now hand to the Analyst analysed, to satisfy myself of its purity or otherwise, and that I undertake not to use any certificate I may receive from the Analyst for the purpose of an advertisement.

Dated this.....day of....., 18....

NOTICES OF BOOKS.

A Dictionary of Science, Literature, and Art. Edited by W. T. BRANDE, D.C.L., F.R.S. L. and E., and the Rev. G. W. COX, M.A. New Edition, revised. London: Longmans, Green, and Co. 1875.

FOR an encyclopædia to satisfy all its readers is evidently impossible. No man, as a rule, is satisfied with the share of attention which his favourite subjects have received. Thus it seems to us that in the work before us an excessive amount of space has been devoted to history, language, mythology, theology, law, and the like, and too little to physical science. Perhaps, however, the preponderating attention bestowed upon the former class of subjects will agree with the taste of the general English public, which is certainly not much given to science. It may be supposed by the editors that the brief notices on physical, chemical, and biological subjects will suffice for the ordinary reader, whilst those who wish for more thorough-going information will seek it elsewhere.

Even the space allotted to the physical sciences and their applications might, we think, in some cases have been more judiciously distributed. Thus the canine disease known as "distemper" is discussed at considerably greater length than pulmonary consumption! So-called artificial manures occupy less space than what may be in contradistinction termed natural manures.

The article on Sewage contains not a few questionable statements, and all processes for its purification and utilisation, except irrigation, are quietly ignored. The idea, that towns may some day expect to get from a ¼d. to ½d. per ton for their sewage is still maintained. We fear that the prevalence of this notion is one of the causes why so much river-pollution still continues, the municipal bodies still holding back till some company is found kind enough to pay them for the privilege of being allowed to purify their refuse.

The article on Water is somewhat elaborate. We note

especially the admission that of the saline impurities the salts of magnesium and calcium are the most objectionable. This is the more important since attempts have been recently made to show that water holding in solution as much as 12½ grs. of anhydrous sulphate of magnesia per gallon—equal, as the reader will remember, to 25 grs. of ordinary Epsom salts—might be safely used as the drinking-supply of a town! One of the Buxton wells, in repute for its gentle purgative properties, contains magnesia equal only to 13 grs. per gallon. This same magnesian contamination, not to be removed by any known process of filtration, is one of the chief objections to the use of the water from Artesian wells.

The important subject Soil is despatched in a dozen lines. The article on the Atmosphere is also brief and unsatisfactory.

We have more especially referred to these heads because they are some of the subjects on which, in these days, men not especially devoted to the study of science may be expected to require correct and moderately full information. We can only regret that these topics have not received an attention more commensurate with that bestowed upon literary subjects. The ability with which the latter have been treated is indisputable, and will doubtless secure for the present edition a continuance of the approval with which the work was formerly received.

The Potato Disease, and the Curl Disease in Potatoes: their Causes and Prevention. By ECCLES HAIGH. London: G. Philip and Son, Fleet Street.

THE author argues that ammoniacal manures have been the prime cause of the potato disease. It appeared, he tells us, just about the time when "high farming" was introduced, while "curl," which he connects with the old, easy-going style of farming, disappeared about the same date. He points out the difficulties attending the fungus theory of the potato rot in a masterly manner. The remedy which he proposes is the avoidance, as far as possible, of highly nitrogenous manures—a recommendation which fully agrees with results very generally, if not universally, obtained.

Wildungen: Its Baths and Mineral Springs. By Dr. A. STOECKER. Translated by C. HARRER, M.D. London: Trübner and Co.

IN many parts of the Continent a very lively interest is felt in mineral springs; not merely by resident physicians, hotel-keepers, and other not quite disinterested persons, but by the general public. Half a century ago it was the same in England. From some cause unknown the fashion amongst us became extinct, and now there are few subjects about which an Englishman—be he robust or invalid, scientific or unscientific—cares less than about Brunnen. From a variety of indications, however, it seems as if our national taste for saline and sulphuretted waters were about to experience a revival. The pamphlet before us gives an account of the mineral springs of Wildungen, in the Duchy of Waldeck, and of the diseases in which they are considered to be beneficial.

The Blowpipe: A Guide to its Use in the Determination of Salts and Minerals. By G. W. PLYMPTON. New York: Van Nostrand. London: Trübner and Co.

THE attention of American chemists seems to be very prominently turned to the study of the blowpipe and its uses in mineral analysis. In addition to the splendid edition of Plattner, which we had the pleasure of noticing some time ago, two smaller, but yet useful, manuals have made their appearance on the other side of the Atlantic. The work before us, though laying no claims to originality, gives in brief space a large amount of valuable matter. We are much pleased to see that in the table of reactions the rarer metals, capable of detection by the blowpipe, have not been omitted.

CORRESPONDENCE.

ON RELATIONS AMONG THE ATOMIC
WEIGHTS OF THE ELEMENTS
WHEN ARRANGED IN THEIR NATURAL ORDER.*To the Editor of the Chemical News.*

SIR,—With reference to the remarks made by Mr. C. T. Blanshard, F.C.S., as to the propriety of including two separate equivalent numbers of one and the same elementary body in the table of atomic weights, I may state that, having worked a good deal in this direction, both with the view of filling gaps in the table of atomic weights, and also of rendering their sequence more in accordance with the natural order, I have come to the conclusion that it is much better to keep strictly to the atomic weights alone. Apart from this, it seems reasonable to regard mercurous chloride as Hg_2Cl_2 and cuprous chloride as Cu_2Cl_2 , the two metals in these compounds being only *apparently*, and not really, univalent. As a dyad, copper has the atomic weight 63.4, and it is hard to see how Mr. Blanshard makes it twice as great.

The Table I. of "Elements in the Order of Atomic Weight," given in my late paper (CHEMICAL NEWS, vol. xxxii., p. 21), is almost identical with one published by me in the CHEMICAL NEWS, vol. x., p. 59, that is, more than eleven years, at which time there was not a single text-book in the language in which the new atomic weights were used. I also then gave a horizontal arrangement of the more important elements, with blanks corresponding to some of the missing members of various groups, and shortly afterwards pointed out the rule, or law, regulating the periodic sequence of the elements when arranged in the natural order of their atomic weights. All this was published and re-published, read before the Chemical Society, and reported in various journals years before M. Mendelejeff had printed anything upon the question. In my new table I have incorporated the atomic weights proposed by M. Mendelejeff for some of the rarer metals, with a few modifications rendered necessary by certain changes in the atomic weights of other elements.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

9, Mincing Lane, E.C., London,
October 4, 1875.REFORM IN THE MANUFACTURE OF
SULPHATE OF AMMONIA.*To the Editor of the Chemical News.*

SIR,—It may interest your many agricultural readers to learn that the back of an old prejudice regarding the colour of this important manurial salt is now in a fair way of being broken.

Hitherto, almost the whole of the sulphate made for sale for agricultural purposes has been produced from brimstone acid, simply because it cannot be made of a "good grey" from pyrites acid; this conventional stipulation as to colour being regularly made by all purchasers of the article.

Impressed with the absurdity of using brimstone acid for an article destined to go upon the same land as soluble phosphate made from pyrites acid, a large English maker recently offered a consumer with whom he had contracted a reduction of five shillings per ton from his contract price if he would take a darker article made from the cheaper acid, but guaranteed equally rich in ammonia (24 per cent) and equally free from sulphocyanides. The consumer being an intelligent practical chemist and manure maker at once closed with the offer, remarking that he was not particular as to colour so long as the article realised the two essential conditions named.

Another firm have also since taken the darker tinted article at a similar reduction from their contract price.

Agriculturists and manure makers, therefore, who are now paying the present high prices for sulphate would do well to acquaint the parties supplying them that they are prepared to forego the question of tint if this concession in price be made.

It is high time that all such adventitious tests of quality as *colour, mechanical condition, &c.*, should be discarded by intelligent men. Farmers are rapidly abandoning guano now that its percentage of ammonia is falling, whilst its fine brown colour remains. The colour test is equally worthless in the case of sulphate of ammonia. "Good grey" has been bought by my own firm which, in appearance, was unexceptionable, but which, upon analysis for ammonia, was found to be largely adulterated with white sand.—I am, &c.,

ONWARD.

PS.—Of course, the consumers of pure *white* sulphate for special purposes in the arts will still be able to get their requirements supplied by manufacturers who make a speciality of the article and require an extra price for it. It is only the "good grey," for manure now made so extensively from brimstone acid which needs to be superseded by the cheaper, but equally guaranteed, make.

REPORT OF THE BRITISH ASSOCIATION
COMMITTEE ON THE ESTIMATION OF POTASH
AND PHOSPHATES.*To the Editor of the Chemical News.*

SIR,—The "Report of the British Association Committee on the Estimation of Potash and Phosphates," contained in your last issue, includes a letter from "a well-known firm of chemists" which has quite astonished my weak nerves. Those "chemists," in declining to give any information upon their methods of analysis, and looking at chemistry, not as a science, but simply as a milch cow, evidently do not at all realise their true position, viz., that they must be prepared at any moment to *justify* their methods before other analytical chemists of recognised standing, which, of course, involves an exact description of their mode of operation. Or, do those gentlemen, whoever they may be, consider themselves as towering so high above the heads of all us poor scientific, analytical, and practical chemists, that we, and the commercial community as a matter of course, must accept their certificates, without questioning, as absolute truth which it is blasphemy to contradict? *Real* chemists need not be told that such pretensions, and the refusal to disclose analytical methods, altogether are utterly irreconcilable with the character of scientific men, and are, in plain words, nothing but the characteristics of people who have every reason to distrust their knowledge and confidence; it matters not whether they have ever so high a standing among chemical brokers and merchants, who are necessarily ignorant of the true qualifications of a chemist.

Pity that Mr. Allen has not published their names, as he would have been fully entitled to do, and that he leaves us to make a guess upon the style of that "well-known firm of chemists, whose results were in some degree the cause of the appointment of the Committee," from the fact of their *not* appearing among his enumerated correspondents. Many of us, in guessing, may not hit far off the mark; but how are chemical merchants, who at present implicitly rely on such people, to find out and brand with deserved scorn the unscientific arrogance of people pretending to belong to a scientific profession? And what good are the labours of the British Association Committee if that "well-known firm of chemists" haughtily despises them, and yet reaps impunity from not being publicly exposed?—I am, &c.,

CHEMICUS.

October 2, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Central-Blatt für Agrikultur Chemie,
Heft 6, June, 1875.

Peroxide of Hydrogen in the Atmosphere.—Em. Schöne.—Peroxide of hydrogen, distinguished by its powerful oxidising action, and often confounded with ozone and with nitrous acid, has been detected in rain by Meissner, Schönbein, H. Struve, Werner, Schmidt, and Fr. Goppelsröder; in snow by Struve; and by Houzeau in rain, dew, and snow. The author commenced in the beginning of July, 1874, an investigation on the occurrence of this body—possibly very important for vegetal and animal life—in rain, snow, natural and artificial dew, and hoar frost, having regard to the time of the day and the season of the year, the temperature, the light, the direction of the wind, &c. Rain falling in large drops is richer in peroxide of hydrogen than drizzle. A decrease is perceptible in long continued rain, but in a very irregular proportion. No distinct difference was found between rain accompanied by electric discharges and other rain. The polar current brings rain poorer in this constituent than the equatorial.

Influence of Forests on Atmospheric Moisture and Quantity of Rain.—The absolute quantity of moisture in the atmosphere appears to differ little at any season of the year in open grounds, and in forests. The relative moisture is, however, greater in forests, the difference being greatest in summer, and increasing with the elevation of the place above the sea-level. According to Ebermayer's view, forests increase the amount of rain only by their action upon the relative moisture of the atmosphere.

Action of Vegetation upon the Physical Attributes of the Soil.—Prof. Wollny.—As to the influence of vegetation upon the temperature of the soil, it appears that ground covered with plants is cooler in summer than plots of the same nature lying fallow: in winter the case is reversed. A soil covered with plants is, except in a very shallow stratum, on the surface poorer in moisture than similar soil which is bare—a phenomenon due to the great evaporation going on from the surfaces of plants. The fact that a soil covered with plants is looser in its texture than bare soil is explained by the consideration that bare ground is pressed down and puddled by the rain.

Constituents and Physical Properties of Pond Soils.—Dr. A. Hosäus.—Certain of these soils contained—Phosphoric acid, 0.7 to 0.85 per cent; potash, 0.42 to 0.53; and nitrogen 0.04 to 0.06. They may contain more than 50 per cent of water, which they retain very obstinately.

Phosphorites of Samland.—Dr. Hoff Meister.—The deposit is 0.3 to 0.5 metre in thickness, and was noticed in 1870 by Brendt. The amount of phosphoric acid ranges from 35 to 0.32 per cent. Oxide of iron and alumina in some cases reach 11 per cent.

Manurial Experiments with Barley.—Prof. Moschini.—The author has made a series of experiments to decide in how far the action of phosphatic manures depends on the amount of phosphoric acid in a soluble condition. The result showed a heavier crop the richer the manure was in phosphoric acid soluble in water.

"Koprosguano" and various other Manures.—By various French chemists.—Koprosguano is a mixture of various guanos of known composition, containing nitrogen = 3.11 ammonia, and a total of about 15 per cent of phosphoric acid.

The Lime-Salts of the Bones.—C. Aeby and F. Wibel.—Recent bones and recent ivory lose on ignition more

carbonic acid than they can take up again on treatment with ammonium carbonate.

Contribution to our knowledge of Vital Changes, and in particular the Process of Respiration of Insects.—O. Bütschli.—In experiments on cockroaches (*Blatta orientalis*) the liberation of carbonic acid was found directly proportional to the temperature.

Recent Investigations on Different Sources of Food for Cattle.

Acclimatisation and Change of Seed.—Professor Haberlandt.—Schübeler maintains that varieties of grain originating in northern countries ripen earlier, and that it is advantageous to take seed from a colder country to a warmer. The author, on the other hand, contends that seed gives better results if grown in a warmer locality than where it is sown.

The Signification of the Decayed Leaves (Streudecke) of Forests, according to their Situation.—Prof. A. Ebermayer.—The total ash decreases with the height above the sea level, especially as regards phosphoric acid.

Influences which determine the Sex of Hemp Plants.—Prof. Haberlandt.

Action of High Temperatures on the Germination of the Seed of Red Clover.—L. Just and Waag.

Germination of Seeds in Nitrous Oxide.—Alfonso Cossa.—Wheat did not germinate in twelve days in an atmosphere of nitrous oxide, whilst similar parcels of grain exposed to air and to oxygen germinated in two days.

Modification of Nitrogen most suitable for the Nutrition of Plants.—Prof. Julius Lehmann.—The experiments undertaken on buckwheat, maize, tobacco, and lupins show that certain plants can utilise nitrogen for their normal development only in the form of nitric acid; others can do this only in the latter period of their growth, and require, in the earlier part of their career, ammonia for vigorous vegetation.

Occurrence of a Diastatic and Peptogenous Ferment in Tares.—E. v. Gorup-Besanez.—See *Ber. Chem. Gesel. Berlin*, 1874, No. 16.

The Place of Fodder-Plants in the Rotation of Crops.

Value of Anthyllis Vulneraria.—Prof. Jul. Kuhn.

A Weed worth Cultivation.—F. Haberlandt.—The author recommends the cultivation of *Saponaria vaccaria*.

Rectification over Burnt Lime.—Bullock.—From *Archiv. der Pharmacie*, 1874, 205, Bd. 11, s. 476.

Examination of French Red Wines for Genuineness of Colour.—Eugen Dietrich.—The red of genuine wines appears brownish in thin layers; if diluted with 50 parts of water its colour is very faint; whilst artificially coloured wines appear decidedly blue-red, even at such a degree of dilution. If diluted with 20 parts by weight of water the behaviour of genuine wines as compared with spurious was as follows:—*Acetate of Lead* 1:10.—In genuine wines colour disappears; liquid becomes dirty and turbid. On heating, small silver-grey flakes with a slight reddish tint appear. Spurious wines yield large curdy flakes of a deep violet blue, which on heating becomes more decided. *Sulphate of Copper* 1:10.—In genuine wines the colour disappears almost entirely; without turbidity. Spurious wines turn violet-blue, with a slight turbidity. *Baryta Water*, 1:10.—Genuine wines lose their colour almost entirely; faint turbidity. Spurious wines turn violet-blue or greenish blue and turbid. Filter-paper steeped in the above tests, and dried, becomes colourless if moistened with genuine wine, whilst coloured sorts give a violet or blue spot.

Investigations on Alcoholic Fermentation.—Dr. O. Brefeld and Wartha.—Not adapted for abstraction.

M. Reimann's Farber Zeitung,
No 35, 1875.

This issue contains an account of the meeting of the Dyers' Association at Berlin. Among other business it was proposed to establish an institution for the theoretical training of practical dyers.

Improvement in the Fermentation Vat.—This improvement, which, though patented, is still kept a secret, consists in a preparation applied to the wool before dyeing, and is said to effect a saving of indigo amounting in some cases to 33 per cent. The prepared wool may be dyed in any kind of vat, including that of Schützenberger and De Lalande.

There are receipts for a fast brown and an olive-green on cotton yarn, an orange for jute, a black for silk garments, magenta, cerise, ponceau, scarlet, lilac, and pansy, for silk rags, and a ponceau for woollen printing.

No. 36, 1875.

The last *canard* on poisonous colours is as follows:—A merchant pared his corns with a penknife. The next day his foot was much swollen, and a medical man called in pronounced him affected with blood-poisoning. The penknife was carefully examined, and on it were found—a few stains of alizarin ink!

No. 37, 1875.

This issue contains an account of a new dye-works at Berlin, and an extract on the subject of poisonous dyes from the *Vossische Zeitung*, according to which certain cotton goods dyed and printed with aniline-violet have been found heavily charged with arsenic. The dangerous articles are of Alsacian origin.

There are also receipts for an orange and blue on calico; for dyeing a light mode grey; a lavender, blue; a greenish mode in two shades; a drab and a reddish mode upon wool and woollen yarns; further, a black and a dark blue for cloth.

NOTES AND QUERIES.

Tar Products.—Can your readers inform me which is the best English work on tar products?—TAR.

Table-Glass Ware.—Can any of your readers favour me with the different quantities of chemicals and other raw materials to be used in the manufacture of fine table-glass ware.—GLASSMAKER.

Purification of Disulphide of Carbon.—Can your readers put me in the way of getting any further information on the subject of the purification of disulphide of carbon by the process described in your last number under the name of Sergius Kern?—R. PAPINEAU.

Society for the Promotion of Scientific Industry—Phosphoric Acid.—Will any readers of the CHEMICAL NEWS kindly oblige me with replies to the following queries:—(1). What is the Society for the Promotion of Scientific Industry? Where are its offices? What is the amount of subscription? Where can its *Journal* be had, and at what price? (2). By what process is phosphoric acid manufactured on a large scale in Germany, and is there any manufactured in England?—AN OLD SUBSCRIBER.

TO CORRESPONDENTS.

W. Sowerby.—Apply to Asher & Co., foreign booksellers, Bedford Street, Covent Garden, W.C.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 830.

THE COPPER-ZINC COUPLE AND ITS EFFECTS.*

By J. H. GLADSTONE, Ph.D., F.R.S.,
Fullerian Professor of Chemistry in the Royal Institution.
(Concluded from page 77).

I propose to occupy the remaining half-hour in bringing before you some of the work that has been accomplished by

means of the copper-zinc couple. On one of the papers handed to you at the door, I have given what has been done at different dates—the chief results, and the chemistry of the operation, which will be perfectly intelligible to the chemists who are present. You will perceive a note explaining that the copper and zinc are not in any definite chemical relationship or quantity, in the formulæ given.

Let me first take the substance which I have spoken of most fully, that is to say, water. There is one experiment that I should like to show you, because it is so illustrative. Zinc alone put into water does not decompose it. Zinc and copper, as I hope to show you presently, do decompose the water. We can, however, take a metal which does decompose water even at the ordinary temperature. It is very much like zinc, but more

WORK DONE BY MEANS OF GLADSTONE AND TRIBE'S COPPER-ZINC COUPLE.

| Date. | Chief Results. | Chemistry of Operation. |
|-------|--|--|
| 1872. | Decomposition of water, and preparation of pure hydrogen | $\text{ZnCu} + 2\text{H}_2\text{O} = \text{Cu} + \text{Zn}_2\text{HO} + \text{H}_2$ |
| 1873. | Direct formation of zinc ethiodide, and | $\text{ZnCu} + \text{C}_2\text{H}_5\text{I} = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{I} \end{array} \right.$ |
| | Preparation of zinc ethyl, | $2\text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{I} \end{array} \right. = \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \right. + \text{ZnI}_2$ |
| | Ethyl hydride, and zinc <i>iodo-ethylate</i> | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{I} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{I} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{H} \end{array} \right.$ |
| 1873. | Preparation of di-amyl, | $\text{ZnCu} + 2 \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{I} \end{array} \right. = \text{Cu} + \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{C}_5\text{H}_{11} \end{array} \right. + \text{ZnI}_2$ |
| | Zinc amyl, and | $2\text{ZnCu} + 2 \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{I} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{C}_5\text{H}_{11} \end{array} \right. + \text{ZnI}_2$ |
| | Amyl hydride | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{I} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{I} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{H} \end{array} \right.$ |
| | Preparation of methyl hydride | $\text{ZnCu} + \text{C}_2\text{H}_8\text{O} + \text{CH}_3\text{I} = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{I} \end{array} \right. + \text{CH}_4$ |
| 1873. | Preparation of zinc <i>isopropyl</i> , | $2\text{ZnCu} + 2 \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{I} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{C}_3\text{H}_7 \end{array} \right. + \text{ZnI}_2$ |
| | <i>Zinc prop-iodide, zinc propyl, and propyl</i> hydride | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{I} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{I} \end{array} \right.$ |
| | | $2\text{Zn} \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{I} \end{array} \right. = \text{ZnI}_2 + \text{Zn} \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{C}_3\text{H}_7 \end{array} \right.$ |
| | | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{I} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{I} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_3\text{H}_7 \\ \text{H} \end{array} \right.$ |
| 1874. | Isolation of di-allyl, and | $\text{ZnCu} + 2 \left\{ \begin{array}{l} \text{C}_3\text{H}_5 \\ \text{I} \end{array} \right. = \text{Cu} + \left\{ \begin{array}{l} \text{C}_3\text{H}_5 \\ \text{C}_3\text{H}_5 \end{array} \right. + \text{ZnI}_2$ |
| | Preparation of pure propylene | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_3\text{H}_5 \\ \text{I} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{I} \end{array} \right. + \text{C}_3\text{H}_6$ |
| 1874. | Preparation of pure olefiant gas and its homologues | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_n\text{H}_{2n} \\ \text{Br}_2 \end{array} \right. = \text{Cu} + \text{ZnBr}_2 + \text{C}_n\text{H}_{2n}$ |
| 1874. | Preparation of zinc <i>ethylobromide</i> , and | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{Br} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{Br} \end{array} \right.$ |
| | <i>Zinc brom-ethylate</i> | $\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{Br} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. = \text{Cu} + \text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{Br} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{H} \end{array} \right.$ |
| 1874. | Preparation of zinc <i>chlorethylate</i> , and direct hydrogenisation of ethylidene | $2\text{ZnCu} + \left\{ \begin{array}{l} \text{C}_2\text{H}_4\text{Cl} \\ \text{Cl} \end{array} \right. + 2 \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. = \text{Cu} + 2\text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{Cl} \end{array} \right. + \left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{H} \end{array} \right.$ |
| 1875. | Complete hydrogenisation of chloroform, and its homologues, and preparation of Acetylene (Investigated by Prof. Thorpe.) | $3\text{ZnCu} + \text{CHCl}_3 + 3 \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{H} \end{array} \right. = \text{Cu} + 3\text{Zn} \left\{ \begin{array}{l} \text{C}_2\text{H}_5\text{O} \\ \text{Cl} \end{array} \right. + \text{CH}_4$ |
| | | $3\text{ZnCu} + 2\text{CHI}_3 = \text{Cu} + 3\text{ZnI}_2 + \text{C}_2\text{H}_2$ |
| 1873. | Conversion of nitrates into ammonia | $4\text{ZnCu} + 6\text{H}_2\text{O} + \text{KNO}_3 = \text{Cu} + 4\text{ZnH}_2\text{O}_4 + \text{KHO} + \text{NH}_3$ |

The new substances discovered during these investigations are in italics.
Cu signifies simply the metal copper, and not an atomic proportion.

powerful in most of its chemical characters, and it has the power of taking the oxygen away from the hydrogen even under ordinary conditions. We will endeavour to show that by throwing the image on the screen. Here is a vessel of water, and here is a little twisted coil of wire made of the metal magnesium. You will perceive that there are bubbles forming upon the metal. Now the water has got warmer, I dare say, by means of that powerful light behind it; still, though some bubbles are formed, you will perceive that the decomposition of the water is going on but slowly. I will ask Mr. Williams just to put in a little of the blue solution of sulphate of copper which I have here; then you will perceive at once that copper is being deposited upon the magnesium, for the magnesium is growing thicker, and becoming rough with the deposition of metal upon it. Now the bubbles are forming in large quantity. You perceive that the copper and magnesium together are acting energetically upon the water, and the bubbles are forming very rapidly and rising to the surface of the liquid. This little experiment then, I think, will illustrate to you very clearly that the two metals in junction are more powerful than one alone, in decomposing water.

Now we will try the same by means of zinc. Here is a good large copper-zinc couple which has been acting for some time, and here is some of the hydrogen gas which has been collected. You see it is working away slowly at the ordinary temperature. I will ask Mr. Williams to change the water—to pour away this water and take some warm water instead. I have put upon the board the amounts produced at different temperatures, in experiments which were performed carefully. At a temperature of 2°C .—that is to say, only just above the temperature of ice—we got during an hour 1.1 c.c. of hydrogen gas. But when we operated at 22°C .—that is to say, a little above the temperature of this room—we got 5.5, five times as much. When it was made warmer (34°C .) then we had 13.9; when warmer still (55°C .), 62 c.c.; and so on. The quantity of gas increased at a very much more rapid ratio than the increase of temperature; so that when we reach nearly the temperature of boiling water, 93°C ., we get about 500 times as much gas produced as when the water was nearly frozen.

This illustrates the effect of temperature. Well, here the action is going on with the warm water. We shall see that the hydrogen gas is coming off more freely than before.

I will ask your attention to this piece of apparatus. It is one which was set up during the Christmas lectures. It was put aside in the laboratory, and I believe has not been touched since. It has been working on during all the time in the cold, and it has been doing its business quietly without stopping. It is still working. Here, in this tube, is an amount of gas which has been collected since yesterday. We have collected these 25 centimetres since about this time yesterday, when the apparatus was placed on the table, and we shall, no doubt, find that this is hydrogen gas. You will observe another result. We have a quantity of white oxide of zinc formed. The zinc has, in fact, turned almost entirely into oxide. We were reckoning just now that it must have given off 4000 c.c. of hydrogen if it went on at the rate that it is going on now; but certainly it has been acting more energetically during the earlier part of these four or five months.

One of Dr. Frankland's greatest discoveries was the discovery of ethyl and of a number of other substances, by acting upon iodide of ethyl by means of zinc at a very high temperature, and at high pressure. In this way he obtained the spontaneously inflammable zinc-ethyl and other bodies. Now we thought that the action which he obtained with difficulty, our zinc-couple would, perhaps, bring about much more readily, and we tried it, and found that such was the case. We have merely to take some of this couple, pour upon it the iodide of zinc, and heat them together, and we find that the iodide of zinc

is gradually decomposed—that a solid substance is formed in the reaction, and that this zinc ethiodide, as it is called, and a gas, are produced as Frankland found. If this zinc ethiodide be heated, it is resolved into iodide of zinc and the spontaneously inflammable liquid, zinc-ethyl. We can produce this in larger quantity, and very quickly indeed, by the use of the new copper-zinc couple. However, it is too slow a process for me to show you just now. I will show you simply some ethiodide of zinc which has been produced, and some of the zinc-ethyl which has been prepared in this way. I will take a little up in this tube, and you see as I allow it to pour down from the end of the tube it catches fire the moment it is brought into contact with the atmosphere.

But this couple will decompose a number of other substances of a similar character—iodides and bromides. It will decompose them much more easily than the zinc itself will, and much more quietly, and we can produce substances which we cannot produce without the couple.

I will next show you zinc-propyl—an analogous body never prepared before; but it has been prepared by this means. It is like the zinc-ethyl in some of its properties, and I will repeat the same experiment to you, and show you that it also is spontaneously combustible. Here we have this liquid. As I allow it to run out it catches fire in the air at once, and from the blazing stream rises oxide of zinc, which floats away in the atmosphere. This, then, is one of the children of the copper-zinc couple, and a fiery child it is, as you see.

But we have some more fiery children. The zinc-isopropyl is still more active than that. I must not dwell too long upon these things. We can produce the ethylo-haloid compounds themselves by bringing their constituents together. We can take this zinc-ethyl, for instance, and warm it with iodide of zinc, when it forms Frankland's ethiodide. By using bromide of ethyl instead of iodide, I can produce a perfectly analogous substance. This ethylobromide of zinc we prepared some time ago. This is a substance which was never prepared before; but which was first obtained by means of the copper-zinc couple, and by heating it we can produce our inflammable zinc-ethyl just as from the iodide.

There is no reason why we should not have a chlorine compound like the iodine and the bromine compounds. This has been prepared by means of the copper-zinc couple. My first idea was to prepare it before you in my lecture to-day; but one does not like to make an experiment for the first time in a lecture-room, especially when dealing with such an inflammable substance as zinc-ethyl. One does not know what its behaviour may be when brought into contact with what it has never been in contact with before. This, therefore, was prepared on Saturday, and this is the first and the only specimen of the substance in the world. Here, then, is a new body which has never been seen before except by ourselves. Well, we must give it a name, of course, and what name shall we give it? We can only name it according to the family to which it belongs, and you perceive its brothers upon the printed table. Against the date "1873" we have the direct formation of zinc ethiodide. That was Dr. Frankland's substance. We produced afterwards the zinc ethylo-bromide, and you will perceive that it is put in italics in the table, because it is a new substance. It is this pearly, crystalline body. This last we must call by the same name, putting "chloride" in the place of "bromide." So it stands as the "zinc ethylo-chloride." That must be the name of this new crystalline substance which we have just produced.

It must be remembered that we are only just launching upon this investigation. If, instead of taking the iodide of ethyl and acting upon it by means of the copper-zinc couple, we mix it with some alcohol, or water, beforehand, we get a different kind of reaction. We get the hydrogen of the water, or the hydrogen of the alcohol,

entering into the matter. That has been going on in this experiment which was started this morning, and I believe that the action has filled this vessel with gas two or three times. In this case the gas is what is called hydride of ethyl. In this other vessel we have a similar substance—hydride of methyl, or marsh gas—the inflammable gas of coal mines, or the inflammable gas which comes off from marshes. It will burn. [The marsh gas was caused to issue from the jar in which it had been collected, and was ignited.]

This is the easiest way, by far, of producing these hydrides; but, at the same time, we are producing something else in the liquid. You who are well acquainted with chemical symbols will observe the chemical equation, and see that it involves the formation of some other body. There is a combination of the zinc and iodine and C_2H_5O . This is a new substance, which we have termed zinc iodo-ethylate. It dissolves in alcohol very freely, but not in water. Here it is. I will show you that it is decomposed by water by pouring a little into the water in this vessel. What we get is a thick precipitate of oxide of zinc and an alcoholic residuum. By similarly treating a bromide, we may get a similar bromine compound, and by similarly treating a chloride, we may get a corresponding chlorine compound. In fact, there are various ways in which these may be produced. I will ask you to look, after the lecture, at this beautiful gelatinous oxide of zinc which is floating about in the liquid.

One hardly knows how to refer to all the various substances that are mentioned in the Table. We will take substances which are perfectly analogous one to the other, as far as composition is concerned. This copper-zinc couple is a quiet means by which we can split them asunder, or, rather, gradually take one element away from the other element; and in this way we can see how they are built up—what we may call their structure. In chloride of ethylene and chloride of ethylidene we have two such bodies, and they are acted upon differently by the couple.

We can produce other bodies by this agency. For instance, here is a specimen of di-allyl. Suppose we take chloroform, or bromoform, or iodoform; we find it easily acted upon. If I were to take iodoform dissolved in alcohol, and put some copper-zinc couple into the vessel, we should see an action taking place, with the production of mixed hydride of methyl and acetylen. This takes a few moments to commence, and then it becomes very energetic in its action. These reactions give about the best illustration that I know of the influence of time. It is very singular that many of them will remain quiescent for a quarter of an hour, or perhaps an hour, without any change being apparent, and then they begin to act, and the action becomes rapid and soon ceases. It is important to be very careful in bringing these substances together in the first instance, because we do not know whether a long time will elapse before the action commences, or whether, as in the case of bromoform, the whole contents of the vessel may be violently thrown out upon the substances being brought together.

Sometimes we are asked the question, "What is the good of these enquiries?" Well, the good is very various. That is generally the last question that we ask in experimenting. It ought to be the last question; but still it is interesting, at least to the public generally, to find that there are some practical results flowing from such investigations. The main results may be of a theoretical order. Our theories, views, or hypotheses, diagrams or illustrations, are all very imperfect. They represent but poorly what takes place in nature. But, by increasing our experiments, and getting more and more to the truth of nature, we advance our theories and improve our knowledge of natural things. It is the same as in higher things, where, I suppose, our first imperfect conceptions gradually become more and more perfect, and we arrive at the knowledge of that which is useful to us, body, soul, and spirit. That may be the usefulness of the copper-zinc couple, as

far as theory is concerned; but, as far as practical purposes are concerned, it has already enabled us, as you see, to make at least some half-dozen new substances, which we have now at our disposal. It has also afforded us an easy means of preparing a great number of other substances, such as these hydrides. It has been employed in one way in analysis. One of the most difficult problems in all analysis, but one which is very important too, is the estimation of nitric acid or nitrogenous substances in potable water—for instance, in river water. A great deal has been written on that subject, and Professor Thorpe has employed our copper-zinc couple for turning the nitric acid into ammonia. We have performed the experiment here. This is some of the nitrate of potash which was employed, and here is some ammonia which has been distilled from it after being acted upon; and here is some of what is called the Nessler's test solution. I will show you that this nitrate of potash will not affect the colour of the test in any way; but, if I take a little ammonia, we shall find a very great change. I have not tried whether I have really got any ammonia in this vessel. Yes, we have a quantity of ammonia, formed by the decomposition of that nitre by means of the copper-zinc couple.

I hope that I have been able in this short time to give you some idea of the principle of this copper-zinc couple, and of the work that is being effected in your laboratory by means of it. I trust that the work will go on, and that we may be able to illustrate more fully in this way several principles which I have had so much pleasure in bringing before you during these lectures "On Chemical Force."

ON THE PURIFICATION OF BROWN SULPHATE OF AMMONIA.

By A. ESILMAN.

In the purification of coal gas from sulphur and ammonia there are obtained, as is well known, several products formerly valueless, but now utilised as cheap materials for the manufacture of vitriol and sulphate of ammonia. The principal purifying material is sulphate of protoxide, or hydrated peroxide of iron mixed with a quantity of sawdust, and when this mixture has been properly employed in the purifiers, it leaves the gas-works containing 30 to 60 per cent of sulphur, and sulphate and sulphocyanide of ammonium (mainly the former) in quantity sometimes reaching 20 or 25 per cent. After washing out the ammoniacal salts the residue is burned in peculiarly constructed furnaces for the manufacture of vitriol.

The sulphate of ammonia obtained from the washings by crystallisation is of a more or less dark red-brown colour, owing to the accidental presence of soluble ferric salts in small quantity, and as it contains all the sulphocyanide originally present in the oxide, is of very inferior value in the market. An easy and inexpensive method of converting it into ordinary sulphate was some time ago devised at the works with which I am connected for a neighbouring firm, and has been worked by them ever since. A supply of gas-liquor is necessary, and the "conversion" is carried on simultaneously with the manufacture of ordinary sulphate. The mode of procedure is as follows:—

A quantity of brown sulphate about equal in weight to the acid, which will be only half the ordinary charge, is put into the empty "blower," and then the acid (not less than 110° Tw.) is run in. On turning on steam from the ammonia boilers an effervescent action sets in due to the escape of sulphocyanogen and its products of decomposition, and the result is its speedy volatilisation. This point can be easily shown to be reached by taking out a small portion of the liquor, diluting with cold water, and adding a little solution of ferric chloride or sulphate. No reddening indicates its absence. The contents of the blower are now finished off in the usual way. The only precautions necessary are to

start with an empty blower, and avoid the addition of water or mother-liquors until the decomposition is completed. Of course the relative proportions of brown sulphate and acid may be varied according to circumstances. When there is a very abundant supply of gas-liquor, more acid and less sulphate may be employed. It is advisable to have a hood over the blower connected with a draught pipe, so as to carry away the deleterious vapours evolved. The cost of the treatment is merely nominal.

That the quantity of sulphocyanide in some samples of commercial sulphate of ammonia is large, may be inferred from the fact that a lot of London sulphate when distilled with slaked lime in excess and the vapours conducted into acid yielded 25 to 27 cwts. white sulphate of ammonia per ton; this apparent paradox being explained by the yield of ammonia produced from the nitrogen of the sulphocyanogen as well as that ready formed. In the absence of soluble oxide of iron such sulphate of ammonia may not show the slightest abnormal colour.

However tempting the presence of cyanogen compounds in products from such exhaustless sources may be to the scientific manufacturer, the present insignificant demand for sulphocyanide salts acts as a complete barrier to their utilisation, and the conversion of sulphocyanide of potassium into the corresponding ferrocyanide by fusion with iron is not such an easy matter on the large scale as laboratory experiments would indicate. Possibly sulphocyanide of barium would give a better result in the desulphurising process, as cyanide of barium is more stable than cyanide of potassium, and is readily converted into potash salt by sulphate of potash.

Manchester, October 8, 1875.

ON THE MANUFACTURE OF EOSINE.

By MM. BINDSCHIEDLER and BUSCH,
Basle, Switzerland.

A. W. HOFMANN, in his interesting work,* has proved that eosine is derived from the resorcine, *i.e.*, from the fluoresceine, and is especially a combination of tetrabromine-fluoresceine and potash.

The fabrication of fluoresceine presents no difficulties now-a-days; owing to the splendid works by Bayer and E. Fischer,† an almost theoretical yield and a very pure product are directly obtained by working on a large scale.

The combination of fluoresceine with bromine also yields an almost theoretical result. The technical fabrication of the resorcine alone presented some serious difficulties a sort time ago. The best source for obtaining resorcine was bresiline, which, according to the interesting observations by Professor E. Kopp, of Zurich, produces, by dry distillation, large quantities of nearly chemically pure resorcine.

Upon the advice of his teacher, Professor E. Kopp, Mr. W. Eglé has undertaken, in the laboratories of the Polytechnic Institute at Zurich, a series of experiments tending to prepare benzino-disulphuric acid, from which the melted soda salt, with an excess of caustic soda, produces resorcine.

According to Mr. W. Eglé's method, we have undertaken in our works trials on a large scale, and we have much pleasure in stating that this method‡ is very practical for making that sulpho-conjugated acid, and consequently resorcine.

The transformation of benzine into resorcine, if very carefully operated, is obtained quite easily and with almost theoretical results. Thus the price of the resorcine is relatively very low at present (about 11s. per lb.), and any quantity of resorcine can be got in commerce, while a little time ago this product was very scarce and only to be found

in small quantities in the collections of scientific laboratories.

The phthalic acid, which is necessary for the transformation of resorcine into fluoresceine, is also to be had plentifully in commerce (price, about 11s. per lb.). The bromine costs about 1s. 9d. per lb. At these prices of the raw material, eosine can now be produced as cheaply as saffranine, and eosine is already offered below 36s. per lb. possessing a purity and bloom of shade far superior to that which it had on its first appearance.

The fluoresceine is easily combined with bromine, by leaving the bromine to act on fluoresceine, which may either be dissolved in glacial acetic acid or finely divided in water; every drop of bromine disappears immediately, and it is difficult to find the right moment when the action of the bromine must be interrupted. On this circumstance alone depends the success of the operation, *i.e.*, the purity and the splendid colour of the finished eosine. The pure fluoresceine gives to silk a very handsome yellow shade. It is a regular yellow colouring matter. The dyeing is effected in water feebly acidulated with acetic acid, adding thereto by degrees the fluoresceine previously dissolved in water with addition of a small quantity of ammonia. By plunging the silk dyed with fluoresceine in water to which a trace of ammonia has been added, the latter immediately disappears, and the yellow colour of the silk is changed into a red shade, which gets the more body the more bromine is added to the liquor. One arrives slowly at the most bluish shade which can be obtained with eosine. If the action of the bromine continues, the colouring matter begins to be destroyed.

It can be proved by this experiment, which is easily performed, that regulating the reaction of the bromine on the fluoresceine is the most important part in making the eosine. By the same process, any shade can be produced on the same skein of silk, from the pure yellow of the fluoresceine to the most bluish of the eosine.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.*

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 188).

Section 4.—Concentrating.

THE causticised liquor having been obtained, the next stage is its concentration, and as it is extremely dilute, being at the very utmost 20° Tw., the concentration is commenced in steam boilers after the method indicated in Dale's patent, the steam from this being used generally in the causticising process.

Still this method of concentration is only followed by a few, for, owing to the corrosive action of the alkaline solution of sodium sulphide, the boilers are very often under repair, and as any negligence on the part of the workmen is apt to be attended with disastrous results, the process, at one time thought so highly of, has gradually fallen into disuse. Any near approach to the salting point should be most carefully avoided, and it is probably the best plan never to allow the strength of the liquors in the boilers to exceed 30° Tw.

In order to preserve the boilers, it would be much better never to allow liquor to be concentrated in them unless the sulphide has been eliminated, either by means of litharge or by the injection of air.

The liquors are concentrated in pans of wrought- and of cast-iron, and heated by the waste heat of the black-ash furnaces. In some works a cast-iron pan is placed next to the furnace and a wrought-iron one at the end of this, and the weak liquor for concentration is sometimes run into the front and sometimes into the back pan first. In other works they are all of wrought-iron, and where any

* *Berliner Berichte*, 1875, p. 62.

† *Moniteur Scientifique*, July, 1875, p. 579.

‡ *Berliner Berichte*, 1875, p. 818.

* From the *Journal of the Society for the Promotion of Scientific Industry*.

fishing is done the pans should be boat-shaped to allow of the easy collection of the salts.

Some works, however, prefer all their pans of cast-iron, they being arranged and set according to position and mode of working. These waste heat pans seldom bring up the liquors to the necessary degree of concentration, therefore self-fired pans are sometimes required to finish off.

These may be either of wrought- or cast-iron, but the latter kind are most generally used. They are set singly or in batteries of two and three; if singly, the waste heat passes under a wrought pan to economise the heat; in the other cases the one fire is made to heat the two or three pans in the series.

There are at least two different methods for concentrating the liquors; one by separating the foreign salts in two stages, the other method separates them in one.

Before describing the first method fully, I will just mention a few different plans adopted by manufacturers in dealing with their waste heat from the black-ash furnaces.

In one works each furnace is furnished with a cast-iron pan, with a wrought one at the end of this. The causticised liquor, after having been well settled, is run into the wrought back pan connected with the furnace, where it generally reaches a gravity of about 28° Tw. From this pan it is run into a cast pan, next the furnace, where it will reach a gravity of 50° Tw., or even more than this. Up to this strength no salts will be deposited, and there is nothing more to do but run off the liquor to make room for fresh.

In another works two wrought pans are connected with each furnace, the front pan being placed directly over the black-ash furnace so that the black-ash arch is between two fires. This is a very expensive setting, repairs are very heavy, and furnaces often under repair, and this is only compensated for by a very little if any extra evaporation.

The weak liquor is run into the pan over the furnace, where it boils furiously, and is then run into the back pan, where it is always withdrawn below its salting point, just above 50° Tw.

In a third instance each black-ash furnace was supplied with three cast-iron boat pans placed behind each other; the causticised liquor was run into the nearest pan, where it reached a gravity of about 24° Tw.; from this it was run into the centre pan, where it became concentrated to about 54° Tw. No salts were deposited in these two pans; but in the third or back pan the liquor often reached 70° Tw., and salts were obliged to be fished out. The clear liquor, after being allowed a short time to settle, left this series for the pots.

When high gravities are dealt with it is found difficult to do so with an ordinary hydrometer to give good and uniform results, and as the caustic liquors possess a progressive boiling-point as they become more concentrated, it is found better to boil until the contents of the pan arrive at a fixed number. This number varies in different works, but a good heat is 280° F. When the pan is found to boil at this temperature, the fires are mostly drawn or allowed to burn out, and the contents of the pan allowed a short time of repose, in order that the suspended salts may be deposited. The time a pan is allowed to settle will, of course, depend upon the pan capacity of the works; it may vary from less than half an hour to over two hours. The settled liquor in the best regulated works is then run off into settlers, where more salts are deposited, and the pan is run up again with partly concentrated liquor, and the deposited salts fished out; the pan is then fired again, settled, and run off as before.

It may be as well to remark that the concentration as above described is effected by boiling down the strong liquor from the waste heat pans in others which are self fired. They may be cast or wrought. If cast, they are generally fired in batteries of two and three; if of wrought-iron they are fired singly, and each pan is from 26 feet to 30 feet in length.

Some manufacturers prefer to fish out the salts from weak liquors, and in this case there is much less caustic mixed with them. In this mode, after running the pan off, some weak but warm liquor is run upon the deposited salts, when they are fished out, after which the pan is filled up and the boiling re-commenced.

The salts fished from the boat pans consist principally of carbonate and sulphate, the former monohydrated, the latter anhydrous; but when fished from weak liquors both are hydrated crystals. The following are two analyses of these salts. A fished in the ordinary way, B fished from weak liquor.

| | A. | B. |
|--------------------------|---------|---------|
| Insoluble matter | 0.384 | 0.214 |
| Sodium sulphite | 2.734 | 0.793 |
| „ hyposulphite | 0.316 | 0.252 |
| „ sulphate | 29.583 | 24.499 |
| „ chloride | 3.978 | 1.872 |
| „ silicate | traces | traces |
| „ aluminate | traces | traces |
| „ carbonate | 27.984 | 22.684 |
| „ hydrate | 15.360 | 7.680 |
| Water (by diff.) | 19.661 | 42.006 |
| | 100.000 | 100.000 |

The separation of these salts is strictly a settling process, and the pans when working require watching and chiselling to prevent the incrustation of any of the salts upon the iron; but after the liquor has left the pans and has been run into the settlers, the next batch of salts in these settlers is separated by the cooling of the liquors, essentially a crystallisation process, and these salts are principally sodium chloride, containing also carbonate and sulphate in lesser quantity. The following are two analyses of these salts:—

| | A. | B. |
|---------------------------------|---------|---------|
| Insoluble (chiefly FeS) | 1.143 | 0.867 |
| Sodium sulphide | traces | 0.077 |
| „ sulphite | 2.734 | 1.013 |
| „ hyposulphite | 0.316 | 0.146 |
| „ sulphate | 9.768 | 5.772 |
| „ chloride | 37.674 | 60.443 |
| „ silicate | traces | traces |
| „ aluminate | traces | traces |
| „ carbonate | 15.052 | 5.683 |
| „ hydrate | 13.440 | 10.773 |
| Water | 19.873 | 15.226 |
| | 100.000 | 100.000 |

The liquor, after having been boiled to 280° F., and the two descriptions of salts separated, is now ready for the caustic pots, where it may be boiled down and fused direct if only for 60 per cent caustic; but if 70 per cent is required it must be concentrated further to separate another batch of salts, which have nearly the same composition as the last. As, however, I intend to speak of the finishing as starting from the liquors boiled to 280° F., I will leave the further concentration for 70 per cent to be described in Section 5.

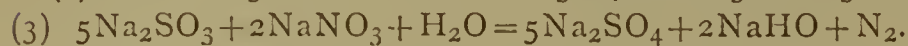
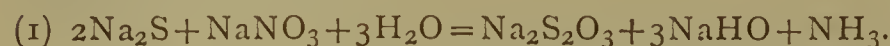
In some works nitrate of soda is added to the liquor in the boat pans to “throw down” the salts as it is commonly expressed, care being taken, however, that always a deficiency is used, as any excess here means so much lost by separation with the salts. If the liquors have been thoroughly oxidised during causticising, no nitre is necessary here, for even if the liquors possess a red tinge and contain some sodium sulphide, still the quantity is too small to admit of the use of nitre.

Muspratt, in his work, gave the formulæ for the reactions which he supposed took place when sodium nitrate was digested at high temperatures with sodium sulphide and hyposulphite; and Dr. Pauli, in 1862, it is stated, studied the action of nitrate of soda upon sodium sulphide. He stated that so long as the boiling-point of the liquid was between 280°—290° F., the sulphide is quietly oxidised to sulphate, sodium nitrate being formed. Now below

280° F. ammonia is evolved, and but little sulphite is produced, so if this reaction takes place at all (and we should expect a nitrate in an alkaline solution and in the presence of such reducing agents to be thus acted upon) it must be at a much lower temperature than 280° F.

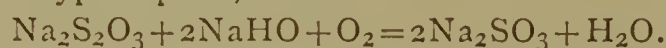
My researches upon this subject have led me to a very different conclusion, viz., that the oxidation of sodium sulphide to the state of sulphate takes place in three distinct stages; first, from sulphide to hyposulphite, then to sulphite, and lastly to sulphate.

The reactions being—



The first reaction takes place below or about 280° F., and the hyposulphite remains for the most part in the liquor; the second commences about 305° F., a little above or below, and the sulphite of sodium which results rises and floats upon the top of the pots as a white scum. When the last reaction commences it would be difficult to say, but in most cases the evolution of ammonia stops at 360° F., and the nitrogen is then evolved in its place.

All these reactions cannot occur unless an excess of nitre has been added to the liquors, and even without the addition of nitre, sulphite is formed at a temperature of about 320° F., probably owing to the action of the air upon the hyposulphite, thus:—



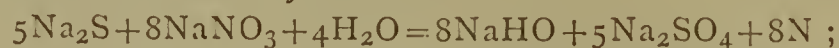
When a high temperature is reached, and even by contact of the liquors with the heated pans, some of the hyposulphite is decomposed after the following reaction:—



Some sulphide gets completely destroyed by the oxidising agency of the atmosphere, and in cases where the liquors have been completely oxidised during causticising, some pots have been finished without a particle of nitre ever going into them or into the liquors in any stage. When nitrate of soda is added to the liquors to be boiled to 280° F., ammonia is evolved and hyposulphite formed, which remains dissolved less the small quantity accidentally decomposed to sulphite, which falls with the salts and may be seen in the preceding analysis.

If nitrate of soda then is added to the pans it should be added in quantity according to the first equation. I have considered this reaction proved by the fact that when nitrate of soda was added to the liquor in a pan in quantity indicated by equation (1), and then boiled to 280° F., 90 per cent of the sulphide was oxidised, while a very small proportion only should have been oxidised if the reduction took place only to nitrite, and sulphate formed.

When the oxidation by means of nitre is effected at the fusion-point of the caustic soda, the reaction is probably not that indicated by Pauli:—



for it must be remembered that the caustic in this stage is in the state of igneous fusion, and no water is present but that which is chemically combined with the sodium oxide. The first method of concentrating or separating the salts in two stages having been described, I will now turn my attention to the process where all the foreign salts are separated in one operation. In this method the weak liquors are concentrated in the two pans at the end of the black-ash furnace, where it reaches a gravity of about 50° Tw. This is only a few degrees short of its salting-point; no fishing is therefore done in these pans, and if through bad setting the pans cannot boil to this strength, it must be made to reach this gravity in self-fired pans. Without any settling it is run into pans in the caustic shed, and fed into caustic pots of the ordinary size and shape, and there boiled until it reaches 280° F., when the fires are drawn and the contents of the pot allowed to settle. The sulphate, carbonate, and chloride, with several other salts, are deposited here and in one

operation, and the supernatant liquor baled off, where it is treated as described in the next section. Weak liquor is then run upon the deposited salts, which are fished out, allowed to drain, and sent into the black-ash mixing. The following are two analyses of these salts:—

| | A. | B. |
|--------------------------------|---------|---------|
| Insoluble matter (chiefly FeS) | 0.742 | 1.004 |
| Sodium sulphide.. .. | 0.116 | 0.097 |
| „ hyposulphite.. .. | 0.274 | 0.718 |
| „ sulphite.. .. | 3.723 | 2.695 |
| „ chloride.. .. | 7.024 | 5.834 |
| „ sulphate.. .. | 22.773 | 26.432 |
| „ silicate | traces | traces |
| „ aluminate | traces | traces |
| „ carbonate | 21.559 | 24.218 |
| „ hydrate | 8.417 | 10.116 |
| Water (by diff.) | 35.372 | 28.886 |
| | 100.000 | 100.000 |

Of these two methods it is doubtful to say which is the better of the two: the expenses of the first are a maximum of labour and repairs, while in the latter method the maximum expense is fuel; but the fuel expense is about equal to that of labour and repairs, therefore it remains an open question which is the best process to adopt?

I will now conclude this section by giving two analyses of the concentrated liquors running into the pots:—

| | A. | B. |
|------------------------|---------|---------|
| Iron sulphide | 0.740 | none |
| „ peroxide | none | 0.071 |
| Sodium bisulphide.. .. | 0.462 | none |
| „ sulphide | 0.531 | none |
| „ sulphite | none | none |
| „ hyposulphite | 12.324 | 19.908 |
| „ sulphate | 2.964 | 0.120 |
| „ chloride | 19.890 | 26.325 |
| „ silicate | 1.758 | 1.555 |
| „ aluminate | 6.984 | 5.784 |
| „ carbonate | 25.840 | 22.506 |
| „ hydrate | 552.000 | 560.000 |
| „ sulphocyanide | 0.342 | 1.240 |

Total solids per litre 623.835 637.509

A is from liquor thoroughly oxidised during causticising, boiled down to 280° F.; it was 93° Tw. at 52° F.

B is from liquor not oxidised, but nitre added in boat pans and boiled to 280° F.; at 52° F. it was 96° Tw.

This liquor should be examined once a day; analyses of these when kept from day to day often come in very useful. The examinations would probably be best kept in the following form:—

| Date. | Deg. Tw. | Deg. F. | Total Na ₂ O. | Caustic Na ₂ O. | Na ₂ S. | NaCl. |
|-------|----------|---------|--------------------------|----------------------------|--------------------|-------|
|-------|----------|---------|--------------------------|----------------------------|--------------------|-------|

(To be continued.)

REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from page 172.)

Estimation of Potash.

The Committee has received comparatively few replies on the estimation of potash in commercial salts containing it, on account of the limited number of chemists having special experience in its determination. The answers

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

received are, however, from chemists of the first rank as authorities on the subject, and the communications appear to be almost exhaustive of the question.

The method of estimation by platinic chloride is employed by all the chemists who have communicated their processes to the Committee, the only differences being in the manipulation and details of the method.

Some chemists recommend the removal of any sulphates by addition of a slight excess of chloride of barium, and some also remove any calcium or magnesium which may be present.

The Committee is in possession of some correspondence respecting a sample of "muriate" which was analysed independently by Prof. Fresenius and Mr. R. Tatlock, and as it throws much light on the origin of the discrepancies often observed in the estimation of potash, the Committee quotes it almost *in extenso*, together with a description of the methods employed by the two authorities above referred to.

Messrs. Wallace, Tatlock, and Clark write:—"We employ the platinic chloride method as described by Fresenius in the sixth edition of his "Quantitative Analysis," with a slight modification, which renders it more applicable to all the numerous varieties as well as strengths of commercial potash salts. In estimating the potassium in the latter the following is the method we employ:—

"After pounding and mixing in the usual way, a quantity of the salt (500 grains) is weighed out and dissolved in hot water, and filtered. The filtrate and washings, being cooled to the normal temperature, are mixed well, made up with water to a fixed bulk (5000 grains), and again mixed. A portion of the solution (100 vol. grains), equal to 10 grains of the original sample, is delivered into a small basin, diluted with 400 grains or so of water, and acidified slightly with hydrochloric acid. About 500 grains of platinic chloride solution (containing at least 25 grains of platinum) are added, the fluid evaporated nearly to dryness on the water-bath. A few drops of water are then added to the residue, and the evaporation repeated to expel the excess of hydrochloric acid. About fifty grains more of the strong platinic solution are mixed with the precipitate, and the whole stirred well, and set aside in a cold place for at least an hour with occasional stirring; the precipitate is then thrown on a very small filter (unweighed), the basin rinsed out with about 10 drops more of the platinum solution, and the precipitate on the filter washed with 10 or 15 drops more. The basin and the filter and contents are then washed with the smallest possible quantity of alcohol at 95 per cent strength, and dried at 100° C. The dried precipitate is transferred as completely as possible to a small capsule, in which it is further dried until it assumes a distinct orange colour, and weighed. The filter with trace of adhering precipitate is ignited on a crucible lid, and the residual metal, with its corresponding chloride of potassium, calculated to potassio-platinic chloride, and the weight added to that of the precipitate.

"The following factors are employed:—To bring the precipitate to potassium, 0.1603; to potash, 0.1930; and to chloride of potassium, 0.3056. These figures are based on Stas's numbers for potassium and chlorine, and Berzelius's equivalent for potassium."

Dr. Fresenius writes:—"I am quite ready to go once more closely into the question regarding the estimation of potassium in commercial potash salts. However, I can only do so occasionally when I am at leisure, for there are a great many experiments still to be made before being able to give a satisfactory answer. As far as I am concerned myself, as well as the analysis in my laboratory, these questions are of no great importance. The great object I have in view is to be accurate; saving time is only a secondary consideration. I begin by entirely separating from the solution the sulphuric acid, lime, and magnesia; then I weigh the pure chloride of the alkali metals, estimate the potassium as platino-chloride of potassium

according to the method given in my "Manual of Quantitative Analysis," make sure that it is quite pure, and generally also estimate the chloride of sodium in the washings by evaporating and heating the residue in a current of hydrogen,* partly to have a check, principally, however, to make sure that it contains no more potassium. This method, however, is not practicable in works because it is too elaborate."

In reference to the estimation of potash, Messrs. Wallace, Tatlock, and Clark also write:—

"It is a notorious fact that while the results obtained by the process we follow as compared with those got by what we may term the alcohol method agree very closely in the case of potassium compounds free from sodium, wide differences have been observed when the potassium salts were of low strength from the presence of sodium compounds. To this fact it would not be difficult to get manufacturers and merchants to testify. This remark applies specially to the case of potassium products from kelp, of which many thousand tons are made in Glasgow every year, some of which contain a large proportion of sodium sulphate, which is not readily convertible into sodio-platinic chloride, but must be converted into chloride by double decomposition with barium chloride,—a tedious and unnecessary process, and one liable to lead to error in any than very skilled hands. Sulphate of potash made from kelp is an excellent example of this kind of salt, as it usually contains about 20 per cent of sodium sulphate in the form of the double salt, $3K_2SO_4 + Na_2SO_4$.

"It was with the view of obtaining a process for the estimation of potassium directly in these compounds that the process we employ was originated, and it has stood the test of practice for fifteen years. It has been objected to our process that the potassio-platinic chloride is soluble to an appreciable extent in platinic chloride solution; but our experience goes to show that in the circumstances of a potassium determination as above described the results obtained are accurate. As an instance of this we may mention that a German firm, supposing that we must necessarily get too low results, handed to us for analysis, in the usual commercial way, a sample of muriate of potash. We found and reported, as the result of the only trial made, 99.95 per cent of chloride of potassium, and were informed afterwards that the sample consisted of pure chloride of potassium, prepared and sent in order to test our process. A further instance will suffice to show the exactness of this mode of estimating potassium in presence of sodium compounds in quantity. A portion of a carefully mixed and pounded sample of muriate of potash, of which we had made previously a complete analysis as usual by this method, was forwarded by our client to Dr. Fresenius unknown to us, with the request that he would spare no pains to arrive at the truth regarding the relative proportion of potassium and sodium salts which it contained. The following are the results of the respective analyses:—

| | W. T. and C. Per cent. | Fresenius. Per cent. |
|-----------------------------------|---------------------------|-------------------------|
| Chloride of potassium | 88.50 | 88.86 |
| Sulphate of potash | 0.13 | — |
| Chloride of sodium | 8.46 | 8.39 |
| Sulphate of lime | 0.18 | 0.22 |
| Chloride of magnesium | 0.50 | 0.47 |
| Insoluble | 0.23 | 0.23 |
| Water | 1.80 | 1.83 |
| | <hr/> 99.80 | <hr/> 100.00 |
| Potash | 55.97 | 56.10 |
| Equal to chloride of potassium .. | 88.65 | 88.86." |

With reference to Mr. Tatlock's method and the above analyses Dr. Fresenius writes:—

* How the proportion of chloride of sodium present is deduced from the weight of the ignited residue is not stated: probably by washing with water, and subtracting the weight of the residual metallic platinum.

"I must object to his washing the precipitate with chloride of platinum. He dissolves by doing so a small quantity of chloride of platinum and potassium, and you see that he makes the chloride of potassium 0.21 per cent lower than I. The discrepancy, however, will scarcely ever be greater. To make sure not to keep any chloride of sodium along with the chloride of platinum and potassium, I first extract the chloride of platinum and sodium with spirits of wine of 80°, and then wash the chloride of platinum and potassium with a few c.c. water, drop by drop; then I evaporate this solution, adding a little chloride of platinum, treat the small precipitate again with spirits of wine, and add the small quantity of chloride of platinum and potassium to the bulk."

In reply to the above criticism the Glasgow Chemists say:—"In his analysis of this sample Dr. Fresenius followed the method described in the sixth edition of his 'Quantitative Analysis;' but, evidently fearing that the digestion of the precipitate with alcohol of even 80 per cent might not free it from sodium compounds, he used a little water, wherewith to ensure the separation of the latter, and afterwards estimated the potassium in the washings obtained, adding this to the main result—a plan which of course can be equally adopted with our process if considered necessary."*

Messrs. Wallace, Tatlock, and Clark further write:—"Our method obviates the necessity of converting sulphates into chloride before applying the platinum process. All that is necessary in the case of these salts, or where they are present, is to add an equivalent quantity, or rather more, of pure sodium chloride, which takes up the liberated sulphuric acid. We believe that the general tendency is to report potassium results too high, not only on account of incomplete removal of sodium compounds from the potassium precipitate, but by reason of impure platonic solutions, which, however pure when originally made from the metal, are liable to contamination through the spent liquors and precipitates being recovered by questionable means. There is almost no limit to the accuracy of this process with care, and in good hands the potash may be estimated easily to within 0.05 per cent."

Mr. W. Galbraith, who has had great experience in the analysis of potash salts by Mr. Tatlock's method, writes as follows:—"The method requires a few precautions, the principal of which are that the pipette be accurate, and that the platonic chloride be pure. Care, too, should be taken that the evaporation should not go to dryness, especially in presence of a large quantity of soda salts, as otherwise the result will be too high. By diluting the solution previous to the evaporation the precipitate comes down in larger crystals, and is more easily filtered and taken off the filter, and is also more likely to be pure. With these precautions, which are easily attended to, the method gives rigidly accurate results, even in the hands of inexperienced manipulators."

Dr. G. L. Ulex, of Hamburg, separates any sulphates by very cautious addition of chloride of barium. He washes the chloro-platinate of potassium with alcohol of 80 per cent. He obtains results reliable to within 0.2 per cent. The process, "although simple, requires to be worked carefully, otherwise serious mistakes will be made."

Mr. M. J. Lansdell says:—"I consider the great secret is to use plenty of platinum, which facilitates the washing out of the sodium salt, and renders the indication by colour (as to when to arrest washing) distinct."

M. Joulié separates sulphates, and then the barium introduced, together with any calcium or magnesium present. He washes the chloro-platinate with a mixture of alcohol and ether. "Absolutely exact results are obtained in five or six hours, whatever the nature of the original sample."

Dr. G. Berrand uses a large excess of platonic chloride, and washes the precipitate with alcohol of 98 per cent. He removes any sulphates with a slight excess of chloride of barium. He remarks that "the most essential point of the whole method is the purity of the chlorate of platinum, which can be well proved by testing it with chemically pure muriate of potash. This, of course, must yield 100 per cent: if more or less, the platinum solution has not been pure. If the platinum solution is correct, even less practiced hands will obtain exact results by the above method, which now is universally applied in the manufactories of our place."

The above replies and correspondence show conclusively the necessity for independent experiments on mixtures containing known amounts of real potash.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 185.)

As the "système Leprince," or "gas mixte Leprince," it was introduced into industrial concerns at Liege, adopted by the town of Maastricht, and by some departments of the Vieille Montagne at Verviers, and was critically described by Verver in 1848 in his work above quoted. Four years afterwards a similar procedure was elaborated by Baldanus and Grüne,† for which Schäffer and Walcker obtained a patent in Prussia. Their process consisted in passing steam through retorts in which coal-shales, turf, and other combustibles were heated to redness. It differs, therefore, from White's process herein that the production of hydrogen and its carburation are effected in the same retort. An ordinary gas retort 8½ feet in length is said to yield, in twenty-four hours, 8000 to 9000 cubic feet of this gas; and in Wagemann's manufactory at Benel, near Bonn, where this process has been introduced, 1 cwt. of coal-shale was consumed per 1000 cubic feet of gas.

Essentially different is the second method of employing hydrogen for lighting, as carried out in 1846 by Gillard, at Passy, near Paris. He fixed on the burners,‡ from which the water-gas issued, baskets of platinum wire, which, on the ignition of the gas, were heated to brilliant whiteness. Hence it was called platinum gas (*gaz platine*). The immobility of the light, even in a strong wind, the dispensing with lamp-glasses, which, according to Verver, absorb 22 per cent of the light, and the brilliance obtained on this principle, must be considered as advantages, although the intensity is not free from objections. Its use was not continued at Passy, but it was introduced by the celebrated firm of Christofle and Co. into their electroplating works at Paris,|| and was employed to light the streets of Narbonne. The hourly consumption of gas being 3.234 cubic feet (=0.1 cubic metre), the light was equal to that of 5.22 normal candles, and, though the lamps at Narbonne were placed at intervals of 50 metres, Verver pronounced the lighting of the streets as perfect.

Latterly, since the preparation of hydrogen has been improved by Tessié du Motay and Maréchal, new attempts have been made in Paris to light up large squares and streets with "platinum gas." Spectators, however, may find justification for the caricatures in the Parisian comic journals of that time, which represent the passengers in the streets, and even infants in arms, and the very dogs in

* As the quantity of solution of platonic chloride solution employed by Mr. Tatlock for washing the precipitate does not exceed 70 fluid grains, the solution of any sensible quantity of the latter seems improbable, and, if occurring, might be altogether prevented by previously saturating the platonic chloride with the potassium salt.

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

† *Journal für Gasbeleuchtung*, 1862, p. 63.

‡ Report by O. Henry, *Journ. Pharmacie* [3], xvii., 105; *Dingler's Journal*, cxvi., 222; and the Reports of Broméis and Ververs.

|| Wagner, "Handbuch der Technologie," 1873, ii., 371.

the gutters, equipped with eye-shades to preserve their sight.

Technical literature has the peculiarity that it records the introduction of novelties, but leaves us in the dark concerning their practical verification. It keeps a tolerably exact register of the births of inventions, but gives a very imperfect account of their career in life and of their deaths. Thus, with a single exception, we are left in the dark as to the permanent results of lighting with hydrogen.

The experiments made with water-gas at the town Elisabeth, in New Jersey, yielded unsatisfactory results, as made known in 1865. Great depreciation of plant, heavy working expenses, and disproportionate consumption of fuel were the causes of failure.

It was, therefore, the more desirable to ascertain in how far the process had proved successful in Europe, and, thanks to the kindness of several correspondents, we have succeeded in obtaining information. The fate of the method in Belgium appears from an extract from a letter which M. L. de Koninck, Professor of Chemistry at the University of Liege, kindly forwarded to the present writer:—

The *système Leprince*, which consists in the introduction of small quantities of water into the retorts in which coal is distilled, had for a short time a certain success (*une certaine vogue*), depending mainly on numerous reclamations by which it was helped out. Its chief advantage was supposed to lie in the fact that it drove the gas out of the retort, a purpose for which an exhaustor or aspirator is now preferred. The system has never been employed for public purposes in Belgium, but merely in certain manufactories. Since the death of the inventor, which took place some years ago, it is no longer spoken of, and has been generally, if not universally, abandoned. This has been the case at Vieille-Montagne.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

THE following instructions have recently been issued by "The National Chamber of Trade," for the guidance of retail dealers. They appear to be drawn up with considerable care, and will no doubt be carefully studied by the class for which they are intended. In any prosecution under the new Act it cannot, at any rate, be urged that the tradesmen have been taken at a disadvantage. It is, however, to be hoped that the inspectors charged with the duty of procuring samples will take care that they are at least as conversant with the provisions of the Act as the shopkeepers may now be fairly supposed to be.

"THE SALE OF FOOD AND DRUGS ACT."

Instructions for the Guidance of Retail Traders.

The term "food includes every article of food or drink, excepting "drugs" and "water."

The term "drugs" includes medicine for internal or external use.

On and after October 1st, 1875, no trader can be convicted (under the 3rd, 4th, and 5th sections) of selling an adulterated article if he can show, to the satisfaction of the Justice or Court, *that he could not with reasonable diligence* have ascertained that the article sold by him was mixed, coloured, stained, or powdered, so as to render the article injurious to health, nor (under the 6th section) if he can also show that it is a recognised article of commerce, or a proprietary medicine, or a compounded drug, or that the extraneous matter was unavoidably due to the process of collection or preparation.

A *verbal declaration* is not now required, but retail traders must, upon delivery to the purchaser, affix, or see that in the case of all mixed articles there is a legibly or distinctly written or printed label on the packet, parcel, or vessel, to the effect that the article is "MIXED."

To abstract from an article any part thereof so as to affect injuriously its quality, *without notice to the purchaser*, will render the vendor liable to a heavy penalty.

Retail traders are advised to obtain a *written warranty* in every case where it is possible.

The purchase of articles for analysis is not limited to officers appointed for the execution of the Act, but it appears that no penalty would be incurred by refusing to sell for that purpose to a private individual.

After the completion of the purchase of an article for analysis *the purchaser must forthwith notify* his intention to the seller or his agent.

The trader must, upon the tender of the price of any article exposed for sale by an officer, inspector, or constable charged with the execution of this Act, sell him the same, under a penalty not exceeding £10.

Precautions to be observed at the Time of Sale.—

1. The purchaser, for the intention of analysis, must then and there offer to divide the article, in the presence of the seller or his agent, into THREE parts.
2. *If required to do so* the purchaser must then and there mark, seal, and fasten up each part, according to the nature of the article, and deliver one part to the seller or his agent,

Note.—Insist upon the article left in your possession being then and there sealed with the *Inspector's seal*, and put the article under lock and key in the event of it being required for future comparison or analysis.

A notice should be given, by the first post after an article has been sold for analysis, to any prior dealer or wholesale house whom it is intended to hold responsible for the result without waiting for the issue.

In the event of the Trader being summoned:—

1. The certificate of the analyst is sufficient evidence with the production of the part of the article retained by the purchaser.
2. The certificate of the analyst must be in the form of the Schedule, or to the like effect.
3. The defendant can require the analyst to be called as a witness by giving due notice to the prosecutor *immediately on receipt of the summons*, and can also tender himself and his wife to be examined on his behalf.

N.B.—The defendant should always be prepared to do this.

4. If the defendant be not satisfied with the certificate of the analyst he can request the Justice or Court of Appeal to submit the sample in his or the purchaser's possession to be examined by the Government Analytical Officers at Somerset House.

N.B.—In case of a refusal by the Justice or Court of Appeal the defendant can give notice of procedure by Mandamus in the Court of Queen's Bench.

5. The defendant cannot claim to be discharged from his summons unless he shall have given due notice to the prosecutor that he will rely on the defence described in the 25th Section.

With regard to Appeal and Defence:—

The defendant has the right of appeal, but must give notice accordingly, and may recover penalties and costs, in addition to any other damages, if he be able to prove—

1. That he sold the article in the same state that he received it, and had no reason to believe it to be otherwise.
2. That he can produce a written warranty.
3. That he could not, with reasonable diligence, have ascertained that the article was mixed, coloured, stained, or powdered, so as to be injurious to health.
4. And that the conviction was wrongful and the claim not unreasonable.

(A direct appeal to the Court of Queen's Bench is advised in preference to the Quarter Sessions.)

On and after the 1st January, 1876, all imported tea will be examined by the Customs.

The Adulteration Acts are repealed.

Special arrangements have been made for sending samples for analysis through the Post-Office.

OBITUARY.

Dr. ROBERT SCHENK, F.C.S.

WE regret to record the death of Dr. Robert Schenk, F.C.S., of Brixton, a gentleman well known as a scientific chemist and teacher.

Dr. Schenk was one of the original abstractors of the Chemical Society, in which capacity he worked hard to the last, and was the author of some useful chemical work. In spite of a constitution sadly enfeebled by long illness he prosecuted his researches under the most adverse circumstances until his death, which occurred suddenly at Epsom, on September 13, at the early age of thirty-seven.

The real worker in science has often to toil hard and long ere he gathers the harvest. In the case of Dr. Schenk it may be said that the seed had been sown and was fast ripening, when the sower was stricken and his earthly hopes blighted. Under these circumstances a professional brother leaves a widow and child almost entirely unprovided for, and it has been thought by some of his friends to be their duty to make this known in the hope and assurance that something will be done to assist the loved ones whom he has left behind.

Subscriptions for this object will be gladly received by—John Newlands, 9, Mincing Lane, E.C.; Alfred Tribe, Dulwich College, S.E.; Arthur Vacher, 20, Great Marlborough Street, W.; or by Professor Gladstone, Royal Institution, who has kindly consented to act as Treasurer.

CORRESPONDENCE.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE ESTIMATION OF POTASH AND PHOSPHATES.

To the Editor of the Chemical News.

SIR,—The least that we could have expected of Mr. Allen was that he should have also published the list of those analytical chemists who have *not* replied to his circular. It strikes me such a list would be found to contain many well-known names, and that he need not in this case have gone abroad to get such names as Fresenius to give it respectability.

There is no hiding the fact that this Phosphate-Potash Committee is a total failure, and that the vague and unsatisfactory discussion of processes now occupying much space in your exceedingly valuable journal will not prove of much service either to chemists or manufacturers. There are standard works on analytical chemistry in three or four languages, and dating almost up to the present hour—persons interested can see there “how it’s done,” or how it ought to be done. If Mr. Allen could kindly show us how we can raise our fees, so that an analytical chemist may have some chance of competing with an engineer or a medical man, we shall all be much obliged to him.

Having been myself in constant practice for nearly twenty years, I have, perhaps, some little right to give my views of the subject, the more so as I am personally unacquainted with Mr. Allen and the learned members of his Committee. I enclose my card.—I am, &c.,

EQUIVALENT.

London, October 15, 1875.

PS.—“Brokers and merchants” show wonderful tact in discovering the most trustworthy analytical chemists. “Chemicus” need have no fear on that score.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I don’t think “Onward” can be acquainted with the manufacture of sulphate of ammonia, or he would know that “good grey” can be made from pyrites acid quite as well as from brimstone acid. I have myself during the last ten years used acid made from brimstone, Norwegian, Westphalian, coast, and also coal pyrites; in the latter case the acid was almost *black*. I must say I cannot see any difference in the appearance of the sulphate; the colour arises from quite another cause—at least, that is my experience.—I am, &c.,

E. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 13, September 27, 1875.

Twelfth Note on the Electric Conductivity of Bodies of Medium Conducting Power.—M. Th. du Moncel.—The author gives the following conclusions as resulting from his experiments:—1. Metallic ores, when they have a certain degree of conductivity, generally produce under the influence of heat thermo-electric effects, and this thermic influence increases or lessens the conductive power of the ore according as its resistance is greater or smaller. 2. Certain metallic ores may present the electro-static and electro-tonic effects so remarkable in hard stones, especially of a siliceous kind; but they join to these effects those resulting from the thermo-electric action, and when these two effects occur simultaneously the latter generally predominate. In all cases these ores are not affected by the moisture of the air. 3. The ores which are in the condition in question are relatively resistant, yet less so than ordinary stones, and, in consequence, heat augments their conductivity. 4. The ores which present a great metallic resistance, and which have not a well developed electro-static capacity, possess a very feeble metallic conductivity, but do not determine sensible thermo-electric currents, and heat slightly augments their conductivity. 5. Ores which only possess a highly-developed metallic conductivity produce intense thermo-electric effects, but heat decreases their conductivity, and the effects which are the consequence of electro-tonic conductivity are not there met with.

Transformation of Blood into a Soluble Powder, and the Chemical, Physical, and Alimentary (!) Properties of this Powder.—M. G. Le Bon.—The author does not describe his process further than by saying that he “operates at a low pressure, and at temperatures not exceeding that of the human body.” His preparation is designed for food, and he states that in “England, Sweden, and Russia various aliments have recently been made with liquid blood, especially for the army; and that the results, in a hygienic point of view, have been excellent.”

Putrefaction Produced by Bacteria in Presence of Alkaline Nitrates.—M. Meusel.—The author concludes that the presence of nitrites in ordinary water is due to the presence of bacteria when the water contains nitrates and organic matter, such as sugar, amylaceous substances, cellulose, &c. The bacteria are the agents of the transmission of oxygen even when it is engaged in a chemical combination. It is probably by reason of the consumption of oxygen which they effect that these animalcules are so dangerous to man. Nitrates are useful as manure, not merely by the nitrogen which they contain, but also by the oxygen, by the aid of which the bacteria destroy the

cellulose. We have here doubtless the indication of a new point of view from which to study the putrefaction of vegetables.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, July and August, 1875.

The only chemical matter in this issue consists of a paper on an arrangement for recovering the iodine sometimes present in phosphorites and liberated during its conversion into superphosphate, and of an account of the phosphate beds of Ciply, in Belgium. Both these papers are taken from the *Comptes Rendus*, and both have already been noticed in the CHEMICAL NEWS.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 21 and 22, September and October, 1875.

These issues contain no chemical matter.

Les Mondes, Revue Hebdomadaire des Sciences, Nos. 3, 4, 5, and 6, Sept. 16, 23, 30, and Oct. 7, 1875. These numbers contain no chemical or physical novelties.

M. Reimann's Farber Zeitung, No 39, 1875.

This issue contains receipts for a black on mixed wool and silk; for a yellowish and reddish Bismarck-brown on wool; a full blue-black for woollen piece-goods; and a paper on finishing woollens.

E. Kopp has discovered in Turkey-red goods, both before and after the clearing process, alumina and lime in the proportion of 1 atom of alumina to 2 of lime. In the cleared goods he detected also tin oxide in the proportion of 1 tin to 5 alumina and 10 lime.

In testing olive oils for Turkey-red dyeing, the same author recommends to pour into a glass 10 vols. of oil and 1 vol. of ordinary nitric acid, adding a few fragments of copper wire, and as soon as gas-bubbles in number penetrate the supernatant oil to mix with a glass rod, wait five minutes, stir again, let stand at 12° to 15°, and separate the oil from the acid, which will have taken a blue colour. After a time this congeals—the quicker the purer the oil. The product—elaidin—is hard and white. If the oil was mixed it congeals more slowly: the product is soft, yellow, or even brownish.

MISCELLANEOUS.

New Degree in State Medicine at Cambridge.—The first examination for this new degree has just been held in Cambridge. The degree is designed as a qualification for holding the post of Medical Officer of Health. Twenty candidates have passed. Among the Examiners we are pleased to observe the name of a well-known chemist, Mr. James Dewar.

NOTES AND QUERIES.

Society for the Promotion of Scientific Industry—Phosphoric Acid.—In reply to the queries of "An Old Subscriber," in the CHEMICAL NEWS, vol. xxxii., p. 194, the Society he refers to is in Manchester, and by addressing it he will obtain any information he may want. The yearly subscription is £2 2s.; the *Journal* is supplied to subscribers only. We cannot give the process for making phosphoric acid, but are prepared to supply it in quantity at 10s. per unit of P_2O_5 delivered, of a strength of 40 per cent P_2O_5 . We will be pleased to receive any further queries and give any information on the subject in our power.—DUNN BROTHERS.

TO CORRESPONDENTS.

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Egremont.—Consult Morfit on "Soap." Published by Trübner and Co.

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- III. On the Condition of the Atmospheres of the Planets.
- IV. The Possibility of a Future Life.
- V. The Channel Tunnel.
- VI. The Arctic Expedition of 1875.

Correspondence, Notices of Scientific Works, Progress of the Various Sciences, &c., &c.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 831.

ON THE VARIATIONS IN THE COMPOSITION OF RIVER WATERS.*

By J. ALFRED WANKLYN.

I HAVE recently had an opportunity of making analyses of the water of the Nile, and have noticed a very interesting feature in that river.

The Nile is pre-eminently subject to flood, the rising of the Nile being, indeed, the chief event of the year in Egypt. Towards the end of May the Nile begins to rise, the increase in size being at first exceedingly gradual. In June the rise is just perceptible, and the river goes on increasing in volume until about the middle of September, in which month it usually attains its greatest size. Afterwards it sinks very gradually, and about Christmas it is low. From Christmas till towards the end of May the Nile remains pretty nearly stationary in size.

The cause of the rise of the river is said to be heavy rains in the months of April and May, the effect of this rainfall requiring the lapse of a considerable time in order to exert its full influence. Possibly, too, the melting of snow on mountains near the sources of the river may concur in flooding the river.

The height to which the Nile rises, as well as the exact period of the rise, varies from year to year, but it may be stated broadly that from the end of May until Christmas the Nile is more or less in flood, and from Christmas to the end of May the Nile is low. The following is a tabular statement of the composition of the water in different months:—

Water of the Nile.

| Date of Sample. | Grains per Gallon. | | |
|------------------|--------------------|-----------|-----------|
| | Solids. | Chlorine. | Hardness. |
| 1874 June 8.. .. | 15.0 | 1.80 | 7.0 |
| July 19.. .. | 13.0 | 0.50 | 6.0 |
| Aug. 12.. .. | 12.0 | 0.30 | 8.5 |
| Sept. 20.. .. | 10.0 | 0.40 | 8.0 |
| Oct. 12.. .. | 11.0 | 0.40 | 7.5 |
| Nov. 12.. .. | 12.0 | 0.50 | 8.0 |
| Dec. 12.. .. | 9.0 | 0.45 | 6.5 |
| 1875 April | 16.0 | 1.00 | 8.0 |
| May 13.. .. | 22.0 | 1.20 | 10.0 |

The remarkable point brought out in this table is the great relative alteration in the proportion of chlorine, that whereas in the beginning of June, just at the beginning of the rise of the Nile, the chlorine amounts to 1.8 grains per gallon; the chlorine sinks to 0.3 grain per gallon when the Nile has attained a great size, and remains at very little above that proportion until the end of the year.

As will be perceived, this diminution of the chlorine is proportionately very enormous, the ratio being 6.1. In order to be quite sure of the facts, I repeated the determination of the chlorine in the month of August, and took the precaution to evaporate down a quantity of the water to about a fifth of its volume before using the standard solution of silver. In this experiment I obtained 0.23 grain of chlorine per gallon of water. I also verified the figure 1.8 for June.

The extent of the fall in the chlorine is, therefore, quite as great as represented in the table. In marked contrast with the variableness of the chlorine, the table exhibits the

comparative constancy of the hardness. On reflecting on the conditions under which the river is placed, the variableness of the chlorine and the constancy of the hardness become intelligible.

The water which swells the Nile in the latter half of the year is storm-water, being thick and muddy (as is well illustrated by the sample of Nile water exhibited in the Sanitary Exhibition). Storm-water sweeps over the surface of the country, without penetrating far below the surface, and we may very readily understand that such water, passing over a country long ago denuded of salt, should carry little or no salt into the Nile, which it dilutes, and so causes to contain only an exceedingly minute proportion of chlorine.

By about Christmas, the storm-water had ceased flowing into the Nile, which, during the spring half-year, must be fed with water which has passed deeper into the ground, and which has undergone concentration by evaporation, in addition to having washed extensive strata, from which, doubtless, it extracts chlorine. We can easily understand how the Nile should become more chlorinous as the spring advances, and how the chlorine should be at the maximum just at the beginning of flood-time.

The hardness, on the other hand, being due mainly to carbonate of lime, we can understand that, from the slightness of its solubility, the carbonate of lime, and consequently the hardness, should be under totally different conditions from the chlorine.

No doubt the *débris* carried mechanically down with the flood-water contains abundance of finely-divided carbonate of lime, so that the storm-water must always be saturated with carbonate of lime. When in flood, the Nile is, therefore, as hard as when it is not in flood, and the comparatively slight variation in hardness at different times will depend upon the varying amount of carbonic acid present in the river.

Although in the Nile the phenomena to which I have just directed attention are exhibited in a very marked manner, yet such phenomena are not confined to the Nile. If the investigation were made, I have no doubt that other rivers—the Danube, the Rhine, and even the Thames, for example—would be found to exhibit something of an analogous character, only in a far less degree; and when they are suddenly flooded these rivers should be less charged with chlorine than at other times. The importance of recognising the different causes to which fluctuation of chlorine in drinking-water is due will be obvious when it is considered how great a stress is laid upon the presence of chlorine as an index to sewage contamination.

Reverting to the Nile, I may append some determinations of the amount of organic matter in it at different times, premising, however, that my analyses were of necessity made on water which had been kept for a considerable period of time. The results are the following:—

| Date when the Sample was taken from the Nile. | Parts per Million. Ammonia. | |
|---|-----------------------------|-------------|
| | Free. | Albumenoid. |
| 8th June, 1874 | 0.01 | 0.10 |
| 10th July, 1874 | 0.04 | 0.25 |
| 18th July, 1875 | 0.36 | 0.28 |

The water of the Nile is, therefore, sometimes quite as much charged with organic matter as the Thames at Hampton Court, where the London Water Companies draw the water. But, like Thames water, it is, no doubt, amenable to wholesale filtration, and a Nile water company ought to deliver excellent water.

As will be observed on turning to the tabular statement above given, the water of the Nile is only about half as hard as the London Thames water. I have also to add that it is not charged to any serious extent with either magnesia or sulphates.

* A Paper read at the Social Science Congress, Brighton.

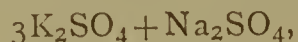
REPORT ON
THE METHODS EMPLOYED IN THE
ESTIMATION OF POTASH AND PHOSPHORIC
ACID IN COMMERCIAL PRODUCTS,
AND ON THE
MODE OF STATING THE RESULTS.*

(Concluded from page 202.)

Statement of Results of Analyses of Potash Salts.

THE information the Committee has received on this subject is limited to the opinions of a few chemists. Without endorsing the whole of the following observations, the Committee believes that the subjoined remarks will be read with interest and advantage.

Messrs. Wallace and Co. write:—"It is quite likely that the sulphuric acid exists in these kelp muriates not as sulphate of potash, but as the double salt,—



discovered in kelp potash salts by Penny, of Glasgow; and if so, the large proportion of sulphates present in kelp muriates (usually from 4 to 6 per cent) would involve a slight alteration in the mode of stating the results, and would introduce sodium sulphate to a small extent. This view, however, even if proceeded upon in practice, would not interfere practically with the commercial value of the sulphates. There cannot be a doubt that the alkali present is carbonate of soda, both from the fact of these muriates *not being deliquescent*, and the impossibility of the existence of carbonate of potash and chloride of sodium together without mutual decomposition, otherwise carbonate of potash could be made by the simple process of mixing solutions of carbonate of soda and chloride of potassium."

Dr. Ulex, of Hamburg, writes:—"Potash, carbonate of potash, pearl-ash, generally contain sulphates (which require to be removed carefully by a chloride of barium solution before estimating the potassium). The whole of the potassium is estimated as chloride of platinum and potassium, and calculated to oxide of potassium. The sulphuric acid present is precipitated with chloride of barium as sulphate of baryta, the chlorine with a solution of silver as chloride of silver; the former calculated to sulphate of potash, the chlorine to chloride of potassium. The oxide of potassium equivalent to these two salts is subtracted from the total oxide of potassium, and the remainder calculated to carbonate of potash. Part of the sample is titrated with sulphuric acid, and noted as carbonate of potassium; subtract from this the carbonate of potash previously found, and calculate the difference to carbonate of soda."

Mr. Wm. Galbraith writes:—"Muriates,' which may be alkaline and contain sodium carbonate (and therefore will not contain calcium and magnesium soluble in water). I should state thus, combining the stronger acids and bases first:—

| | |
|-----------|------------|
| Potassium | Sulphate. |
| Sodium | Chloride. |
| | Carbonate. |

"When they contain calcium and magnesium soluble in water they should be stated thus:—

| | |
|-----------|-----------|
| Calcium | Sulphate. |
| Potassium | Chloride. |
| Magnesium | |
| Sodium | |

"In the case of 'artificial sulphates,' which contain iron, calcium, and magnesium, in addition to potassium and sodium, and are usually acid, the results may be stated thus:—

| | |
|-----------|-----------|
| Hydrogen | Sulphate. |
| Calcium | Chloride. |
| Potassium | |
| Iron | |
| Magnesium | |
| Sodium | |

"The free acid I state as sulphuric acid, as I cannot believe that it exists as hydrochloric acid, considering the heat of the furnace during the manufacture. Of course it is evident that the acidity will not be really due to 'free sulphuric acid,' but to an acid sulphate, probably acid potassium sulphate, $KHSO_4$. Lumps of chloride are often to be found in salt-cakes and potassium sulphates of decided acid reaction. Of course carbonates should follow the same rules as the above."

Mr. M. J. Lansdell holds the following opinions:—"I think, in this as in all other instances, it is a mistake to give detailed analyses showing any particular arrangement of acids and bases combined. I advocate a simple statement of the elements (or acids and bases) separately, and any combining of them I am inclined to look upon as "padding" only (to use an expressive word), and as having weight only with the uninitiated. I do not object to a statement of any one (say a base) as being equal to a salt, not in the sense that that amount of that salt is present in that sample, but as a trade valuation of the base present according to a well-known or usual standard for its valuation. I find the practice of latter years, among our clients, is to ask only for certain determinations (in potash salts generally of potash only, or of potash and its equivalent amount of sulphate of potash or chloride of potassium), and not for detailed analyses, thus getting them done at a less fee. However, I should see no objection if the Committee thought fit to prescribe a mode of statement for detailed analyses which they found suited to the requirements of the trade, it being understood such analysis (quoted perhaps as the 'B.A. statement' or 'B.A. analysis') was only a statement in a conventional form. Yet a statement of the elements (or acids and bases) determined with at most their amounts in equivalent proportions (each equivalent proportion = 1 of hydrogen) would give to each manufacturer an easy means of making all calculations useful to him as to value, or the capabilities of the articles for separation or manufacture thereof of any compound, and would not parade a lot of fictitious or suppositious information to impose upon or awe the ignorant. I incline to the belief that every analyst should have respect to the ends sought, and need not go beyond them. A trader only finding some constituent or constituents of value for his purpose, should be accommodated with such on paying properly for them, and should not be led to require as 'the thing' a lot of other information, involving greater trouble and higher fees, to the limitation of general reference to the chemist. The sooner the public learns that chemists do not want to take advantage of them, but only to do what is of use to them, and that fees are not to be regulated by the number of items given (any more than an amount of money by the number of coins of various values it may be paid in, but also by the intrinsic value of each), the better I think it will be."

In the foregoing report the Committee has attempted to give an *epitome* of the very voluminous replies which have been received. It will be perceived that there are many points on which the evidence is very conflicting, and the Committee feels it impossible to recommend with confidence any particular process or processes, unless the special conditions of accuracy are very clearly defined. The large amount of information amassed during the past year has indicated very distinctly the directions in which further research is desirable, and the Committee therefore begs to be re-appointed, believing that before the next meeting of the Association it will be able to complete the proposed experiments and enquiries, and make a full report on the whole subject it was appointed to investigate.

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

The Committee has been re-appointed with a further grant of £20.

Communications should be addressed to the Hon. Secretary, Mr. A. H. Allen, 1, Surrey Street, Sheffield.

THE CONSTITUTION OF URIC ACID.

By S. E. PHILLIPS.

It is well for a young athlete to ever have before him a task which, by better skill or strength, he may hope some day to surmount; in my case, however, other considerations are paramount. I have, indeed, projected a type of murexide constitution which might cover its genesis from tartronyl, nitro-phenyl, cresyl, or naphthyl bodies, but have hesitated to publish that which does not seem to well satisfy the end so much desiderated.

The amount of labour employed in the endeavour has been far more than I can promise in the future, with declining brain-power, and I must bequeath the difficulty to good friends, who may not be scientifically friendly.

As Strecker and Bayer have done so much in the matter, the hope is that, in spite of modern idiosyncrasies, they may go on to complete the history of alloxantin and the beautiful Tyrian dye, murexide.

Meanwhile, we offer the following section of that study having reference to the constitution of uric acid.

As the products of ordinary combustion are chiefly water and carbonic acid, so some of the products of human or animal combustion are notably urea, uric acid, and their analogues.

The heat- or life-giving process is, perhaps, a kind of nitrile reaction, by which ordinary materials are burnt or condensed to more ultimate products, as if the leading

type of animal function were -2HO , while the converse assimilation in the vegetable kingdom involved a building up of the ordinary materials under the dominion of $+2\text{HO}$.

The thought is, that solar power is consumed in one phase and expended in the other.

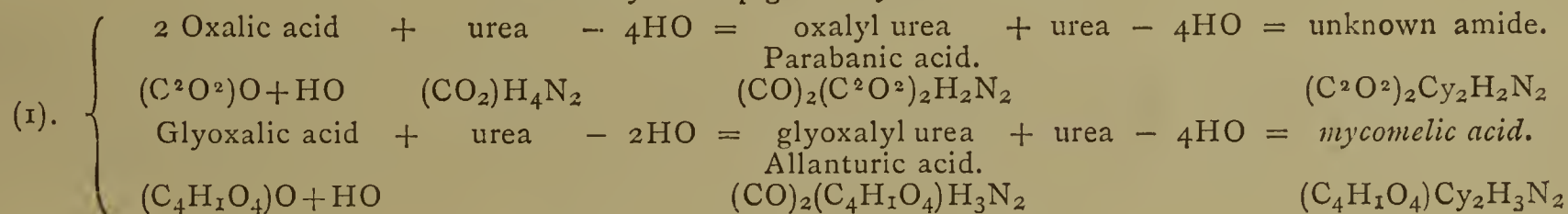
That the urates, cyanurates, and others are not salts in any proper acceptation of that term, whether mono-, di-, or tri-basic, is a demonstration we must leave for the paper referred to, confining attention to the tabular genesis of uric acid and its analogues. (See below.)

In regard to the double lines of Nos. 1 and 2, the first thing to notice is the ready susceptibility of interchange between the upper and lower series—under hydride influences the two radicals, oxalyl and mesoxyl, readily pass into glyoxyl and tartronyl, and *vice versa*; and great has been the penetration to establish this much amid such complex materials, further darkened by imperfect types and confused nomenclature.

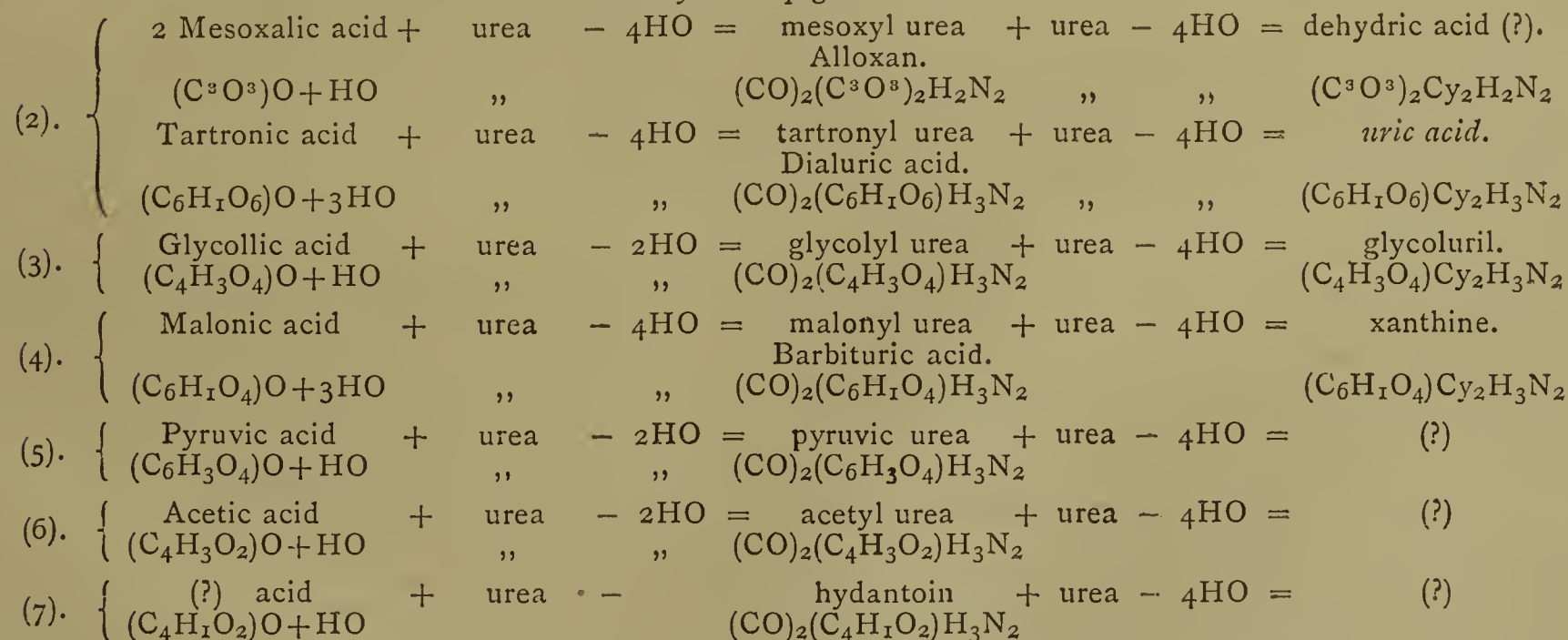
The folly of calling amides acids is well portrayed in this tabular series. Column 2 are all admittedly monureides. In the case of alloxan the nomenclature is exceptionally correct. We have alloxan and alloxanic acid—one the amide or urea, the other amide $+2\text{HO}$, or the aminic acid; but oxalyl urea is called "parabanic acid," and the true acid form "oxaluric acid," and in a similar way malonyl urea is called "barbituric acid," &c. This also extends to column 3, where mycomelic acid, by another mode of genesis, is called "alloxanamide."

If the concretionary salts of lime and potash with uric acid be truly such, then it would follow that caffeine was a tribasic salt, and zinc amide would be a mono-, di-, or tribasic salt of zinc. All of which is equally absurd in sight of the fact that amides and ureas may have metal or other replacements of H. An urate of potash is similar

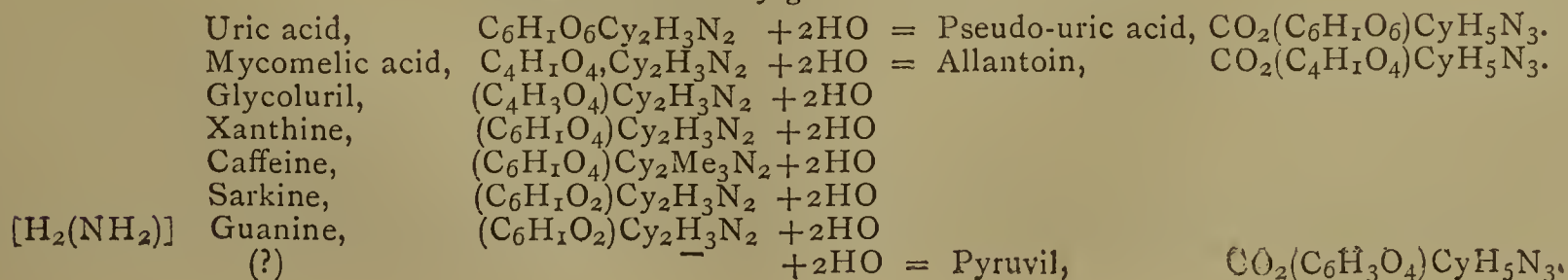
The Oxalyl Group gives Mycomelic Acid.



The Mesoxyl Group gives Uric Acid.



Ultimates inversely give Pseudo-Acid Bodies.



moved by means of perforated scoops, even for the production of 60 per cent caustic, while in some works it is not removed.

It is, however, imperative to remove it in making 70 per cent caustic, and whether nitre has been added or not, the scum appears to have the same composition, as the following analyses will show:—

| | A. | B. |
|-------------------------|---------|--------|
| Iron peroxide | traces | traces |
| „ sulphide | 0.139 | 0.346 |
| Sodium sulphite | 51.408 | 57.120 |
| „ hyposulphite | none | traces |
| „ sulphate | 6.831 | 5.377 |
| „ chloride | 5.265 | 6.172 |
| „ silicate | 0.225 | traces |
| „ aluminate | traces | traces |
| „ carbonate | 15.408 | 13.013 |
| „ hydrate | 20.800 | 17.672 |
| | 100.076 | 99.700 |

A was from liquor boiled to 320° F., the liquors oxidised during causticisation, but no nitre added to pans.

B was from liquor boiling at the same temperature, but nitre added in the boat pans, and it may be worthy of remark that both samples were pressed and dried before analysis.

These salts are in some works put straight into the black-ash mixing; in others they are first washed with weak liquor; a different plan is followed by some, who put them into the strong pans, where the sulphite, sulphate, and carbonate fall with the other salts, the chloride and caustic being dissolved. No other precaution being necessary for 60 per cent caustic, I will now turn my attention to the preparation of 70 per cent.

The liquors after boiling to 280° F. contain too many salts to always give 70 per cent with ease and certainty, so when this strength is required the best plan is to boil until the contents of the pot reach 320° F., and again allow it to settle. Chloride, carbonate, and sulphite now settle out, as may be seen in the following analysis:—

| | |
|--------------------------|---------|
| Iron peroxide | 1.054 |
| Sodium sulphite | 3.603 |
| „ hyposulphite | 0.442 |
| „ sulphate | 1.146 |
| „ chloride | 41.535 |
| „ silicate | 0.174 |
| „ aluminate | 0.544 |
| „ carbonate | 11.488 |
| „ hydrate | 19.840 |
| Water (by diff.) | 20.174 |
| | 100.000 |

When making 70 per cent caustic by the plan of separating the salts in one operation, the liquor from the black-ash boat pans is boiled directly to 320° F., and allowed to settle from twelve to twenty-four hours, after which the supernatant liquor is baled off for finishing.

The boiling of the liquor is then continued, and when the temperature of the liquor has reached 355° F. it will solidify well on cooling and will contain about 53 per cent of alkali. The temperature of the pot then rapidly rises until at about 400° F., when very little steam seems to be evolved, though the contents of the pot still contain nearly 20 per cent of water; at 460° F., a few degrees above or below, the caustic will contain as nearly as possible 60 per cent of alkali, at 470° F. it will contain about 61 per cent, and at 500° F. it will contain about 64 per cent.

About this time there is very little motion to the contents of the pot, and in a short time the heat has risen above the range of a mercurial thermometer. There is at this stage an evolution of some pungent matter due to the action of the caustic soda upon organic matters present in the solution, and which probably is of several kinds, and

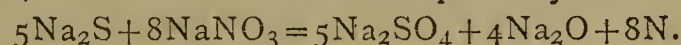
with this the surface of the pot becomes covered with graphite. The cover is then placed on the pot and the fire urged until the workman declares it “up to heat;” the oxidation of the sulphides may then commence, and may be effected by two different methods; first, by the injection of air, and secondly, by the means of nitre.

In the first case air is blown into the caustic, which is now in the state of igneous fusion, until the sulphide of sodium is nearly oxidised to sulphate; a trace of sulphide is always left in at this stage, for if completely oxidised here, the action of the air would be sufficient to give a shade of green to the finished caustic, owing to the formation of a little sodium manganate. Many samples of commercial caustic soda will contain traces of sulphide, but there should be none in the best qualities.

Some manufacturers use a small excess of nitre, and destroy the green colour afterwards by the addition of sulphur or sodium hyposulphite, which latter is generally known in a caustic works as “crystal.” In the case of oxidising with sodium nitrate, this salt is added cautiously in order to avoid excess, a trace of sulphide being also left in as in the last method.

Whether the sulphide in this stage of its oxidation passes through the states of hyposulphite and sulphite into sulphate is difficult to say. Probably not, for a hyposulphite could not exist at this temperature, though there is just the possibility of its being split up at the instant of its formation into sulphate and sulphide. Sulphate is the ultimate product, associated, however, with minute quantities of either sulphite or sulphide.

If the oxidation takes place as indicated by Pauli, the water must be eliminated from his equation, for the caustic is in the state of igneous fusion, and contains no water in excess of that necessary to form the hydrate of soda; the reaction then would probably be—



After the oxidation has been nearly completed, a sample is withdrawn (preferably in a mould such as is used by pharmacists for casting the sticks of caustic potash in) and examined for its amount of total alkali. In this state it is a stick of coloured caustic, the intensity of the colour depending upon the mode of working, and appearing from a light brown to a deep red. If 60 per cent is being prepared the samples may be of the following composition:—

| | A. | B. |
|------------------------|--------|--------|
| Sodium hydrate | 82.193 | 83.566 |
| „ carbonate | 2.404 | 3.174 |
| „ chloride | 6.000 | 8.664 |
| „ sulphate | 7.337 | 3.629 |
| „ silicate | 0.284 | 0.223 |
| „ aluminate | 1.216 | 0.231 |
| „ sulphide | 0.018 | 0.025 |
| Insoluble | 0.492 | 0.386 |
| | 99.944 | 99.898 |

A is a sample of the contents of a pot at this stage from a works where the solution of the bottoms was introduced into the operation pan.

B is from the same works when the bottoms were packed and sold, consequently not re-introduced into the process.

From the strength of the caustic as found by experiment the quantity of salt necessary to reduce it to 60 per cent is calculated, which is added, and the pot is again brought “up to heat,” after which the fires may be allowed to burn out, and the pot settled. After allowing to stand for a time, which may vary from six to eighteen hours as the two extremes, but which is naturally about eight hours; the settling takes place as mentioned in Ralston’s patent; “the oxide of iron is precipitated to the bottom of the vessel,” and besides this the alumina separates itself completely from the sodium hydrate and falls to the bottom of the pot with the iron oxide as aluminate of soda, which is completely soluble in water.

It is upon this settling process that the excellence of the caustic depends, and in some works where there is plenty of pot room, it is customary to allow the pots to settle until a thick crust has formed upon the surface before it is allowed to be packed.

Some pots absolutely refuse to settle well, and this generally happens when there is only a minimum amount of iron oxide in suspension with a considerable quantity of aluminate of soda, which, of itself, is so dense that it falls through the hydrate to the bottom of the pot, and the small quantity of iron oxide seems to be retarded in its settling by this dense liquid.

This bad settling often happens when liquors are dealt with which have been completely oxidised during causticisation. The sodium sulphide has been oxidised to hyposulphite, which does not dissolve the iron of the concentrating pans; the pans are saved, but at the expense of bad settling caustic. If, however, the liquors have not been oxidised, the sodium sulphide will dissolve the pans with the production of the sodium iron sulphide, but the caustic obtained from these liquors will settle with ease and rapidity.

In my opinion this difficulty may be sometimes overcome by the introduction of some of the iron oxide; the deposit from the solution of bottoms when the temperature of the contents of the pot is about 400° F. It is a well known laboratory fact, that traces of precipitates often refuse to settle, and remain suspended in liquids for long periods; but when the same precipitates are present in large quantities, the precipitation is easily and rapidly effected. Apply this reasoning to the case of bad settling caustic, and there is no doubt that the modification I have mentioned will give good results.

Sometimes, although clear when well fired, the pot will assume a milky tinge when cooling, and after cooling in the drums a portion will be found slightly discoloured; but on solution in water a minute quantity of a white precipitate is obtained, which precipitate sometimes becomes slightly brown by exposure to the air, and consists chiefly of alumina and lime coloured with minute traces of iron or manganese.

This precipitate is probably a calcium aluminate, and inquiries on its formation have generally led to the fact that through some negligence on the part of the workmen lime has been introduced into the process, either through the medium of non-settled causticised liquor, or, what I have several times found, that dried vat waste had been employed by the finisher to correct his over-nitred pots, or had been introduced by another workman out of spite towards the finisher.

When the caustic has settled sufficiently it is baled into thin sheet iron drums for sale, the doubtful part near the bottoms being either baled into the next strong pot, or sometimes sold as discoloured caustic, while the bottoms are plunged up, and, when sold, they are packed in drums, but when dissolved they are ladled into iron bogies to solidify, and when set are broken up.

Where a large amount of very light coloured bottoms are obtained from a pot they are sometimes baled into the next pot, and often something may be gained by this mode of working; but where the percentage of bottoms seems on the increase, every care should be taken to eliminate the alumina from the process, or at any rate reduce its amount to the minimum.

Good white caustic soda is also made from red liquors, both from Gossage's process, and also from the over heat black-ash pans. The *modus operandi* is nearly the same as has been just described; the only difference consists in separating a larger quantity of salts, for the proportion of "salts" to caustic soda is much greater than when vat liquors are used. It is usual to boil to a higher temperature before settling, to settle longer before finishing, and to well crust the pots before packing.

The red liquors from the black-ash pans are generally of a gravity of 62° Tw. The following is an analysis of them:—

| Sp. gr. 61½° Tw. at 56° F. | | | | |
|----------------------------|---------|--|--|--|
| Iron sulphide | 0'313 | | | |
| Sodium bisulphide | 0'195 | | | |
| „ sulphide | 6'256 | | | |
| „ sulphite | 16'022 | | | |
| „ hyposulphite | 7'858 | | | |
| „ sulphate | 14'848 | | | |
| „ chloride | 65'526 | | | |
| „ silicate | 9'677 | | | |
| „ aluminate | 1'031 | | | |
| „ carbonate | 79'966 | | | |
| „ hydrate | 194'400 | | | |
| „ sulphocyanide | 0'261 | | | |
| „ ferrocyanide | 0'423 | | | |
| Grammes per litre | 396'756 | | | |

I now proceed to give some full analyses of the finished caustic, starting with white 60 per cent.

| | A. | B. |
|------------------------|--------|--------|
| Sodium hydrate | 72'774 | 75'246 |
| „ carbonate | 1'419 | 2'536 |
| „ chloride | 18'800 | 17'400 |
| „ sulphate | 6'462 | 4'398 |
| „ sulphite | 0'063 | 0'027 |
| „ silicate | 0'304 | 0'297 |
| „ aluminate | trace | trace |
| | 99'822 | 99'904 |

It will be seen by the above analyses that the insoluble matter as well as the sodium aluminate has been separated by subsidence; this occurs likewise in 70 per cent, as may be seen in the following analyses:—

| White 70 per cent. | | | | |
|------------------------|---------|--------|--|--|
| | A. | B. | | |
| Sodium hydrate | 83'840 | 89'600 | | |
| „ carbonate | 4'686 | 2'481 | | |
| „ chloride | 6'522 | 3'919 | | |
| „ sulphate | 4'526 | 3'419 | | |
| „ sulphite | 0'025 | 0'025 | | |
| „ silicate | 0'463 | 0'304 | | |
| „ aluminate | trace | trace | | |
| | 100'062 | 99'748 | | |

Now follow some bottoms from 60 per cent caustic soda.

| | A. | B. | C. |
|--------------------------|---------|---------|--------|
| Insoluble matter | 23'000 | 1'948 | 4'664 |
| Sodium hydrate | 58'888 | 70'896 | 71'866 |
| „ carbonate | trace | none | 0'722 |
| „ chloride | 6'135 | 14'040 | 10'729 |
| „ sulphide | 0'132 | 0'054 | 0'116 |
| „ sulphite | 0'151 | 0'063 | 0'074 |
| „ sulphate | 5'534 | 3'526 | 4'624 |
| „ silicate | 0'683 | trace | trace |
| „ aluminate | 5'661 | 9'556 | 7'133 |
| | 100'184 | 100'083 | 99'928 |

These analyses show where the alumina and oxide of iron has gone.

A was from a pot very red before salting.

B was from a pot, the liquors being thoroughly oxidised during causticising.

C from liquors only partially oxidised during causticising.

The following analyses will serve to show the nature of the insoluble matter:—

| | A. | B. |
|---------------------------|---------|---------|
| Graphite | 2'146 | 1'179 |
| Iron peroxide | 93'000 | 94'006 |
| Calcium oxide | 4'332 | 4'289 |
| Manganese oxide } | 0'522 | 0'526 |
| Magnesia, &c. } | | |
| | 100'000 | 100'000 |

A was the insoluble portion of the bottoms A, and B the insoluble portion from the C bottoms in the same series.

Before concluding, I think I should state what is published concerning white caustic soda, as if I did not I might be taxed with not acquainting myself with the bibliography of my subject. From what I can learn nothing has been written save the single paper of Dr. Pauli in June, 1862. We have wonderfully improved in the manufacture since 1862, and as we have had no record of what has been done and what is going on now, therefore I hope this paper may be deemed worthy of a place amongst technological records.

SIR CHARLES WHEATSTONE.

MANY of our most eminent scientific men pass away after a life of useful scientific labour without attracting much attention from the outside world. Their death is mourned only by those who were devoted to them by ties of relationship or personal friendship, and only when we lose a Faraday or a Wheatstone does the public mind realise the great loss science has sustained. Identified as he was with the practical development of telegraphy, the name of Wheatstone was familiar to all, and the fact of the later years of his life having been devoted to subjects connected with electricity has led even the scientific world to lose sight of his valuable work in other branches of physics. As early as 1823, while engaged in the manufacture of musical instruments, Charles Wheatstone published a paper on "New Experiments on Sound," and on looking through the list of his published papers one recalls the value of his experiments in connection with sound and light. Still it is as the electrician that Wheatstone rose to the first rank in science, and, as we have already said, it is the conspicuous part he played in the invention and application of the electric telegraph that raised him so high in popular esteem. In 1834 Professor Wheatstone was appointed Professor of Experimental Philosophy at King's College. In 1836 he was elected a Fellow of the Royal Society, when he read a paper entitled "Contributions to the Physiology of Vision," and this led to the invention of the stereoscope, which he first exhibited at the meeting of the British Association for the Advancement of Science in 1838.

In 1868 Wheatstone was knighted in recognition of his scientific services, but thirteen years before the Emperor of the French had appointed him a Chevalier of the Legion of Honour on account of his application of the Electric Telegraph. He was also a Member of the French Academy. At the sitting of the Academy last Monday week M. Dumas announced that Sir Charles Wheatstone was lying ill at the Hotel du Louvre. On the 20th inst. the sad news of his death was telegraphed to London. Previous to the removal of the body from Paris to London a funeral service was held at the English Church in the Rue d'Aguesseau, when Lord Lyons and a deputation from the Academy of Sciences were present. MM. Dumas and Tresca referred in feeling terms to the loss which science had sustained; they also referred to his scientific labours, and to the important discoveries with the electric telegraph which would immortalise his name.

The funeral took place at Kensal Green Cemetery on Wednesday last. Many eminent friends and co-labourers were present at the grave. The coffin plate bore the simple inscription—

SIR CHARLES WHEATSTONE,
DIED OCTOBER 19, 1875.
AGED 73 YEARS.

The following list of papers by Sir Charles Wheatstone is abridged from the Royal Society catalogue:—

1. New Experiments on Sound. *Thomson, Annals of Phil.*, 1823.
2. Experiments on Audition. *Quart. Journ. Sci.*, 1827.
3. Description of Kaleidophone. " " 1827.
4. Resonances of Columns of Air. " " 1828.
5. Transmission of Sounds through Solid Linear Conductors, and Subsequent Reciprocation. *Journal Roy. Inst.*, 1831.
6. On Purkinje's Figures. *Brit. Ass. Rep.*, 1831.
7. Bernoulli's Wind Instrument (Theory). *Brit. Ass. Rep.*, 1831.
8. On Chladni's Figures. *Phil. Trans.*, 1833.
9. Velocity of Electricity and Duration of Electric Light. *Phil. Trans.*, 1834.
10. Prismatic Decomposition of Electric Light. *Brit. Ass. Rep.*, 1835.
11. Imitation of Human Speech by Mechanism. *Brit. Ass. Rep.*, 1835.
12. Thermo-Electric Spark. *Phil. Mag.*, 1837.
13. Physiology of Vision. *Phil. Trans.*, 1838.
14. Binocular Vision. *Brit. Ass. Rep.*, 1838.
15. Electro-Magnetic Clock. *Proc. Roy. Soc.*, 1840.
16. Electro-Magnetic Telegraph. *Sturgeon, Ann. Elect.*, 1840.
17. Letter to Col. Sabine on Meteorological Instruments. *Brit. Ass. Rep.*, 1842.
18. Constants of Voltaic Current. *Phil. Trans.*, 1843.
19. Meteorological Registers (Electro-Magnetic). *Achives l'Elect.*, 1844.
20. Juxtaposition of Several Colours. *Brit. Ass. Rep.*, 1844.
21. Electro-Magnetic Chronoscope. *Comptes Rendus*, 1845.
22. Determination of Solar Time by Polarisation. *Brit. Ass. Rep.*, 1848.
23. Foucault's Rotation of Earth. *Proc. Roy. Soc.*, 1851.
24. Physiology of Vision. *Phil. Trans.*, 1852.
25. Binocular Microscopes. *Trans. Mic. Soc.*, 1853.
26. Fessil's Gyroscope. *Proc. Roy. Soc.*, 1854.
27. Powers for Arithmetical Progression. *Proc. Roy. Soc.*, 1854 and 1855.
28. Submarine Cable of Mediterranean. *Proc. Roy. Soc.*, 1854 and 1855.
29. Aluminium in Voltaic Series. *Proc. Roy. Soc.*, 1854 and 1855.
30. Automatic Telegraphy. *Comptes Rendus*, 1859.
31. Prof. Charles Wheatstone and T. R. Robinson, Report of Committee on Captive Balloons. *Brit. Ass. Rep.*, 1843.

SOCIETY OF PUBLIC ANALYSTS.

THE following circular has been issued by the Local Government Board, and, as expressing the views of that department on the "Sale of Food and Drugs Act," should be read with care by all Public Analysts:—

County Authorities.

THE SALE OF FOOD AND DRUGS ACT, 1875.

Local Government Board, Whitehall, S.W.,
30th September, 1875.

SIR,—I am directed by the Local Government Board to draw the attention of the Town Council to the Sale of Food and Drugs Act of the last Session (38 and 39 Vic., c. 63), which will come into force on the 1st of October, 1875.

In accordance with the recommendation of the Select Committee of the House of Commons upon the Adulteration of Food and Drugs Act, 1872 (35 and 36 Vic., c. 74), the present statute repeals that Act, together with the Adulteration of Food and Drink Act, 1865 (23 and 24 Vic., c. 84), and the 24th section of the Sale of Poisons and Pharmacy Act, 1868 (31 and 32 Vic., c. 121), and, whilst re-enacting several of the provisions thus repealed, it has made many important amendments in the previous law.

The following statement shows the most material of these amendments:—

Appointment of Analysts.

Express power is now given to the Local Government Board, by section 10, to require, in the case of any future appointment of an Analyst, satisfactory proof of his competency. They are, moreover, empowered to qualify their approval by such modifications with respect to the period of appointment and removal, or otherwise, as they may think proper. It must, however, be distinctly understood that these provisions do not in any way relieve the Local Authority from the responsibility of satisfying themselves that the person appointed by them is in every respect qualified to discharge with efficiency the duties of his office.

Another important amendment is, that in future no Analyst is to be appointed for any place in which he is engaged, either directly or indirectly, in any trade or business connected with the sale of food or drugs.

The Act of 1872 prescribed as the qualifications of an Analyst that he should possess competent medical, chemical, and microscopical knowledge; but section 10 of the new Act requires that he should possess competent knowledge, skill, and *experience*.

The Act, however, in no way interferes with any existing appointment.

In consequence of the difficulty which has been experienced in obtaining the services of a competent Analyst for small areas, section 11 empowers the Town Council of any borough to engage the services of the Analyst for the county or any neighbouring borough, and the Board hope that the Local Authorities referred to will freely avail themselves of this new power. At the same time, they remark that the facilities thus afforded by the Legislature to meet the difficulty referred to has removed any ground that may have previously existed for neglecting to comply with the requirements of the law.

Duties of Analysts.

Complaints have been made that, when a long interval has been suffered to elapse between the taking of the sample and the making of the analysis, in the case of commodities liable to decomposition, a change has often taken place in the constitution of the article, which has rendered the analysis unreliable. These complaints are met by section 13, which requires that the analysis shall be made with all convenient speed; and it will be seen, by reference to the note to the form of certificate given in the schedule, that, as regards perishable articles, the Analyst is to report specially whether or not any such change has taken place.

Under the repealed Acts, the Analyst was required to specify in the certificate whether, in his opinion, the article was adulterated, and in the case of articles of food and drink, whether they were so adulterated as to be injurious to the health of the consumer. In the present Act a form of certificate is prescribed, which requires him to state the parts or percentages of the foreign materials; but he will be at liberty to express therein his opinion as to the purpose for which the mixture was made, and also whether or not the ingredients are injurious to health.

The Act of 1872 required the Analyst to make to the Authority by whom he was appointed a quarterly report, showing the number of articles analysed and the nature of the adulterations detected. Every such report must, for the future, specify the result of each analysis and the sum paid in respect thereof, and must be presented at the next meeting of the Authority. Certified copies of all such reports are to be annually transmitted by the Authority to the Local Government Board. (See section 19.)

Proceedings to obtain Analysis.

Under the Act of 1872 the only officers who could be employed to obtain samples for analysis were inspectors of nuisances, inspectors of weights and measures, and inspectors of markets. Section 13 authorises the employ-

ment of medical officers of health and police constables for this purpose, in addition to the inspectors before referred to, and not only the Authority appointing such officers, but any Authority charged with the execution of the Act may direct them to procure samples.

Another important amendment will be observed in section 14, which requires the purchaser to notify to the seller, after the purchase has been completed, his intention to submit the article purchased for analysis, and to offer to divide it into three parts, each to be marked and sealed or fastened up. If such offer is accepted, he is to deliver one of such parts to the seller and one to the Analyst, and to retain the third himself, for production in case of proceedings. If the offer is refused, the purchaser is to divide the article into two parts, retaining one himself, and delivering or sending the other to the Analyst.

Hitherto it has been necessary for the officer of the Local Authority personally to deliver the samples to the Analyst. This provision having entailed considerable expense and inconvenience, especially in cases where the Analyst resided outside the district, it is provided by section 16 that if he does not reside within a distance of two miles of the residence of the person requiring the article to be analysed, the sample may be forwarded to him by post in a registered packet, subject to any regulations of the Postmaster-General.

It has frequently happened that a trader has refused to allow a sample to be purchased when he has had a suspicion that it was required for analysis. Section 17 now imposes a penalty not exceeding £10 upon any trader refusing to sell, for analysis, samples in such quantity as shall be reasonably requisite of any articles exposed for sale, if the officer tenders the price for the same.

Description of Offences.

In lieu of the somewhat complicated provisions of the previous Act as to the offences of adulterating articles with injurious ingredients, and of selling the same when so adulterated, the present Act (sec. 3) imposes a penalty of £50 for mixing, with intent to sell, any article of food with any ingredient so as to render the article injurious to health, or for selling any article so mixed, the offender being liable to be imprisoned for six months, with hard labour, for every second and subsequent offence.

Section 4 imposes similar penalties on any person who, except for the purpose of compounding in accordance with the demand of the purchaser, mixes, with intent to sell, any drug with any ingredient so as to affect injuriously its quality or potency, or who sells any drugs so mixed.

By a further amendment (section 5) proof of guilty knowledge on the part of the defendant is not required from the prosecutor; but the defendant may show that he had no knowledge of the adulteration, and that he could not, with reasonable diligence, have obtained that knowledge.

The principal offence created by the Act of 1872 was that in relation to the ordinary retail sale of articles of food which had been adulterated, although not with injurious or poisonous ingredients; but, as there was no statutory definition of the term adulteration, there was a great want of uniformity in the administration of the law, and considerable hardships were in consequence inflicted upon some branches of the trading community.

It is obvious, moreover, that there may be other fraudulent practices which do not necessarily constitute adulteration, such as the substitution of one article for another, or the admixture of one article with another of the same kind, but of inferior quality. The term adulteration, therefore, is not used in the present Act: and in future it will constitute an offence to sell, to the prejudice of the purchaser, any article not of the nature, substance, and quality of that demanded. It will not, however, be an offence to add to food or drugs any matter or ingredient required for their production or preparation of articles of commerce in a state fit for carriage or consumption, provided that the addition does not fraudulently increase the bulk, weight, or measure of the article, or conceal its in-

ferior quality. Exceptions are also made in favour of proprietary medicines and patented articles; and the seller is also protected when the article is unavoidably mixed with extraneous matter in the process of collection or preparation.

Section 8 further amends the law, in the case of compound articles, by enabling the seller to protect himself against proceedings if, with the article, he delivers to the purchaser a label, distinctly and legibly written or printed, to the effect that the article is mixed. It is necessary, however, that the matter added should not be injurious to health, or intended fraudulently to increase the bulk, weight, or measure, or to conceal the inferior quality of the compounded article. The giving of a false label renders the person liable to a penalty of £20.

While these alterations have been made to meet the reasonable objections of traders as to the uncertainty of the law, it will be seen that section 9 constitutes a new offence, by providing that no person shall, with the intent that the same may be sold in its altered state without notice, abstract from any article of food any part of it, so as to affect injuriously its quality, substance, or nature; and no person shall sell any article so altered without making disclosure of the alteration, under a penalty not exceeding £20. This amendment will, for example, render the fraudulent abstraction of cream from milk an offence punishable summarily.

It will be observed that, with respect to tea, special provision is made by section 30, under which all imported tea will be subject to examination by persons appointed by the Commissioners of Customs; but, although this provision will doubtless operate as a protection both to the public and the trading community, it will not exempt any seller of tea from the proceedings to which he may be liable under the provisions before mentioned.

Before concluding this part of their circular, the Board are desirous of removing an erroneous impression which appears to prevail in certain localities, viz., that the special legal provisions made by the Licensing Act, 1872, with regard to the offence of adulterating beer, are still in force.

It is true that statute carried enactments on the subject, and a schedule of adulterants of beer was appended to it. Moreover, certain regulations, framed with regard to the then state of the law, were issued, under which the officers of the Commissioners of Inland Revenue and the police were in the habit of instituting prosecutions in cases where the percentage of salt and other substances was considered excessive. The Act of 1872, however, together with the schedule, was repealed by the Licensing Act, 1874, with the express intention that proceedings for the offence of adulterating beer should thenceforward be placed on the same footing as those in respect of other articles.

Proceedings against Offenders.

An important amendment in the law will be found in section 21, which enables a defendant to tender himself and his wife to be examined on his behalf.

It will also be observed that the Justices of Court of Appeal may in their discretion, upon the request of either party, cause any article to be sent to the Commissioners of Inland Revenue to be analysed by the chemical officers of that department at Somerset House, the expense of such analysis to be paid by the complainant or defendant, as the Justices may direct. It will also be competent for the defendant to require the Analyst to be called as a witness, and the parts of the articles retained by the purchaser to be produced (section 21).

As it is important that great care should be observed in forwarding the samples to the Commissioners of Inland Revenue, and that the analysis should be effected with the greatest despatch consistent with accuracy, the Commissioners have prepared instructions for the guidance of the Clerks to the Justices in performing the new duty imposed upon them. A copy of these instructions is appended to this circular, and the Board suggest that the Court of Quarter Sessions should cause them to be com-

municated to the Clerks to the Justices in the several Petty Sessional Divisions of the County.

In connection with proceedings against offenders, the Board may further point out that it will be open to the defendant to prove that he is protected by any provision or exception contained in the Act with reference to compounded articles. He will be entitled to be discharged if he proves, to the satisfaction of the Justices or Court, that he bought the article as the same in nature, substance, and quality as that demanded of him, and with a written warranty, that he had no reason to believe that the article was otherwise, and that he sold it in the same state as when he purchased it; but he will be liable to pay the costs of the prosecutor in such a case, unless he has given him due notice of his intention to rely on this defence.

Section 27 constitutes the forging of a warranty a misdemeanour punishable by imprisonment, and imposes a penalty of £20 for the misapplication of warranties and the giving of false warranties.

Section 28 enables a person in an action brought by him for breach of contract on the sale of any article of food or of any drug, to recover the penalty incurred by him, together with the costs in relation to the proceedings under the Act, if the article was sold to him as being of the same nature, substance, and quality as that which was demanded of him, and he purchased it not knowing it to be otherwise.

Application of Penalties.

Penalties recovered under the Act by the officers of a Local Authority who have appointed an Analyst, or agree to the acting of an Analyst within their districts, are to be paid to them, and by them to such Authority, to be applied towards the expenses of executing the Act.

The Board have thought it right not to confine their observations to those provisions of the Act which relate more immediately to the duties devolving upon the Court of Quarter Sessions; but in drawing attention to a statute of so much importance, they have adverted to the chief alterations in the law which affect the trading community and the public, and which may be summed up as follows:—

As regards the Trading Community.

It protects the seller—

- (1). By permitting those practices in the established usage of trade with respect to the addition of harmless ingredients not intended fraudulently to increase the bulk or weight of the article, or to conceal its inferior quality, which clearly ought not to constitute an offence.
- (2). By enabling him to protect himself in the case of a mixed article, by affixing a label to it.
- (3). By giving him the right, when he has a written warranty, to plead the warranty as a defence.
- (4). By providing that, if convicted, he may, in an action against the wholesale vendor for breach of contract, recover the costs of his conviction, if he proves that the article was sold to him as being of the same nature, substance, and quality as that demanded of him, that he purchased it not knowing it to be otherwise, and that he afterwards sold it in the same state.
- (5). By requiring the purchaser, when he intends to have the article analysed, to divide the sample, and leave one part with the seller.
- (6). By providing, in the case of tea, that it shall be examined by officers of the Customs at the port of landing.
- (7). By enabling the seller and his wife to be examined as witnesses on his behalf.
- (8). By authorising the Justices, where the result of the analysis is questioned, to have the article referred for analysis to the laboratory at Somerset House.

As regards the Public—

- (1). The former law only protected the public against adulterated or mixed articles; but the new Act protects the purchaser against the delivery of

any article which differs in substance, nature, or quality, from the one demanded.

- (2). It punishes the seller who abstracts any part of an article so as to affect injuriously its quality.
- (3). It prevents the sale of articles, mixed with ingredients not in accordance with the demand of the purchaser without a label indicating that they are mixed.
- (4). It enables medical officers of health and police constables, in addition to the inspectors authorised by the former law, to obtain articles and submit them for analysis when directed to do so.
- (5). It assists the Local Authority of a small district in obtaining the services of an efficient analyst by empowering them to engage the analyst of another Authority; and it enables a purchaser, in a district where there is no analyst, to obtain analyses from the analyst of another district.
- (6). It compels the trader to sell a sample for analysis on demand.
- (7). And, lastly, it renders the law more intelligible, and therefore more practicable, accessible, and certain.

It will be seen, therefore, that whilst some of the amendments which have been made afford to the trading community the reasonable protection to which they were justly entitled, others have rendered the law much more stringent and effectual in the interest of the public.

I am, Sir,

Your obedient servant,

(Signed) JOHN LAMBERT,
Secretary.

To the Clerk of the Peace.

Regulations to be observed in transmitting articles for analysis to the Commissioners of Inland Revenue:—

- (1). The sample retained by the purchaser, as stated in sections 14 and 15 of the Act, should be carefully sealed up and secured either in paper or in a box, as the case may be.
- (2). The seal used should bear a motto or device not in common use, to enable its identity to be sworn to.
- (3). If sent through the post, the instructions issued by the Postmaster-General for the transmission of such samples should be carefully carried out, and the parcel should be addressed to—

THE COMMISSIONERS OF INLAND REVENUE,
Inland Revenue Office,
Somerset House,
London, W.C.

The Principal of the Laboratory.

And in addition to the nature of the contents being stated on the front of the packet, as enjoined by the Postmaster-General, the name of the place whence sent should be stated.

If dispatched by railway or other conveyance, the address above given, with the name of the place from which forwarded, will be sufficient.

- (4). At the time the parcel is dispatched, by post or otherwise, a letter should be sent by post to the Principal of the Laboratory, apprising him of the transmission of the sample for analysis, and stating the nature of the alleged adulteration, and such other particulars as may be considered necessary to facilitate the examination of the sample.

ammonia and freedom from sulphocyanide, can be made from pyrites acid, it cannot, in the experience of the largest makers, be produced from this material of the orthodox "good grey" hue.

When I say pyrites, I mean "Spanish," the leading kind, and which, on account of its richness, cheapness, and abundance, has now all but driven the varieties of which "E. H." speaks out of the English market. It is quite certain that the sulphate from Spanish pyrites acid is of a brownish grey tint. I may add that years ago one of the largest and wealthiest sulphate manufacturing firms made a determined effort to produce a white or "good grey" article from this acid, but completely failed, as, indeed, all such attempts merely to improve the colour of manures deserve to do.

Had the same energy been devoted to the introduction of the dark grey sulphate, thus boldly attacking and meeting a most unfounded and unchemical prejudice, success would long ago have been achieved and a great deal of valuable money might have been saved.—I am, &c.,

ONWARD.

PS.—"E. H.'s" "good grey" from acid of other kinds of pyrites has now very little practical importance. The extensive importations of Rio Tinto (Spanish) ore have already brought down the price of pyrites 30 to 40 per cent, and it is quite clear that the owners of the Tharsis, Masons, Rio Tinto, and other Spanish mines will soon be the only pyrites people in the market. In fact, I heard a large proprietor in one of these companies say recently that the copper in the ore would pay them if they had to give the sulphur away.

"GOOD GREY" SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—Until I read "Onward's" letter, I should have pronounced it incredible that in this year of grace, 1875, makers of sulphate of ammonia for manure should be compelled by their customers to use expensive brimstone vitriol, because pyrites vitriol will not give them a "good grey" product. After this, a bucolic demand that chemists shall henceforth use the divining rod in determining the value of soils would not be very surprising intelligence.

Why, in the name of tender mercy, did not Providence give them "good grey" guano or snow-white muck?

If "Onward's" indictment of this rare piece of humbug has not sufficed, perhaps the following facts may give the *coup de grace* to the superstition:—

To farmers and all whom it may concern, let it be known that large quantities of sulphate of ammonia are produced by lixiviating the "sulphuretted oxide" of the gas works, a material always containing more or less of the compound so poisonous to vegetation—sulphocyanide of ammonium. Now, if the manufacturer take this lixiviated solution and (after adding to it sufficient gas-liquor to precipitate its iron) evaporate it to the crystallising-point, he will get a sulphate of as "good" a "grey" as can be desired; but, let it be remembered, it will contain the whole of the poisonous salt originally present in the oxide. Suppose, further, that it contains 5 per cent of the sulphocyanide, it will, upon determination for ammonia, show the required 24 per cent, and the injury to the farmer's fields will be the first indication of its worse than worthless quality.

Will it be believed, in the face of these facts, that contracts for sulphate of ammonia are regularly made without a word of reference to the sulphocyanide? I have been shown two to-day, one of them for 175 tons, in which the only conditions are "good grey" and "24 per cent of ammonia!"

If I were buying sulphate, I would say—"Good grey!" Make it as black as my hat if you like, but it must have 24 per cent of ammonia and be wholly innocent of sulphocyanide.

MID-DAY.

CORRESPONDENCE.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I would briefly reply to "E. H." that, although sulphate of the best quality, as regards percentage of

ESTIMATION OF PHOSPHORIC ACID BY THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—As the above process does not seem to be included in the Report on the methods employed for this purpose by the British Association, Bristol Meeting (*vide* CHEMICAL NEWS, vol. xxxii., p. 159), I may be pardoned for soliciting the attention of some of your many readers to it here.

The process is based upon—

- (A). The beautiful opalescence communicated to *pure boric acid* by a certain proportion (to be determined as a standard by the balance) of *pure phosphoric acid*, before the blowpipe.
- (a). *Substances* which, thus treated, give *directly* this opalescence.
 - (1). Alkaline phosphates, in extremely small proportion; as, if an alkaline borate is formed, the opalescence is *dissolved* to a clear glass.
 - (2). Cast- or pig-iron, and sometimes wrought ditto.
 - (3). Phosphides of metals proper.
 - (4). Some *tourmalines*, *axinites*, or analogous minerals, containing many basic oxides, the trace of phosphoric acid with which is apparently uncombined.
- (B). Phosphates of the "alkaline-earth" metals.
- (C). Phosphates of "earth" metals, as, *e.g.*, aluminum.

(A) class opalescence is compared in a boric acid bead of 50 m.grms. placed under a lens, with the standardised phosphated boric acid bead, also of 50 m.grms., and the amount of PO_5 estimated by an ordinary calculation of ratios; the standard amount of PO_5 being about 2.5 m.grms., or in the proportion of 5 per cent, when the appearance caused is like that of a noble "opal," *i.e.*, blue by reflected, and reddish yellow by transmitted, light.

(B) class form opaque white balls (like snowballs) floating in the pellucid boric acid bead, and may be separated from that (if desired) by boiling in distilled water, which dissolves the bead, but not the balls. The latter, however, must be decomposed *in the bead*, which cannot be done (as is the case with carbonates or sulphates, &c., of these earths) with the blowpipe alone. The most ordinary and, therefore, useful examples are—

- (b) Calcic phosphates, and
- (b') Magnesic phosphates.

Magnesium phosphates are (so far as my experience goes) the most obstinately coherent, and therefore difficult to decompose, of any; so that this base may be thus suspected.

(C) class remain utterly undecomposable and insoluble as white amorphous fragments in the pellucid boric acid bead under any amount of mere heating.

The latter, (B) and (C), classes are treated in the same manner, as follows:—

Hydric sulphate is the best reagent for disengaging phosphoric acid,* but to apply its solution in water brings us into the region of "wet," and out of that of purely pyrognostic analysis, to illustrate the latter of which methods alone is at present my object.

About one-tenth (in volume) of *magnesium* sulphate is therefore heated before the blowpipe in a 50-m.grm. bead of pure boric acid, and the resulting opaque white ball dissipated, and no more, by the cautious addition of crystallised potassium carbonate; for, if too much be added, an alkaline borate is formed, which dissolves a large proportion of phosphoric acid to a clear glass, and thus renders it invisible. The smallest speck of "earthy" or "alkaline earthy" phosphate now treated in this bead before the blowpipe is at once decomposed, the eliminated phosphoric acid affording the usual blue opaline matter to the bead on cooling, and a sufficient quantity of the phosphatic assay

* I am not aware if this well-known fact has been applied to the treatment of patients suffering from concretionary phosphates in the bladder, joints, &c.

is thus added until the former is exactly equal in depth of opaline tint to the standardised bead (which has, of course, had an equal quantity, by weight, of potassium carbonate and magnesium sulphate added to it), when a sum in proportion concludes the business.

Organic phosphates—or, rather, phosphates derived from organisms—as urinary, biliary, or gouty concretions, are rather more difficult to assay, and require special treatment, as described in my work, "Pyrology," page 189.

The last equivalent of *water* (given off even by the most intensely calcined lime), communicated by nearly all substances to pure *boric acid* before the blowpipe, also tinges that with an opaline tint on cooling, though not nearly so blue or pure as that afforded by phosphoric acid; but the addition of potassium carbonate dissolves away the opalescence of the former never to return, while that of the latter returns as strongly as ever by the simple addition of fresh-fused boric acid.

It will be observed, from the above, that a *quantitative* assay of phosphoric acid is here rather suggested than detailed, and I have not, in fact, yet carried the matter out in all its details; but there can be no reasonable doubt of its possibility, and meantime, as a detective of the presence of phosphoric acid, I am willing to back this pyrological method, before competent judges, against the best (known) "wet ways"—as, for instance, Sonnenschein's—having thus detected this acid in *Lapis lazuli*, "pure" manganese binoxide, &c., where it was not supposed to exist.—I am, &c.,

W. A. Ross.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 14, October 4, 1875.

Results Obtained in Attempts at the Industrial Application of Solar Rays.—M. A. Mouchot.—The author's apparatus is composed of three distinct pieces—a metallic mirror with a linear focus; a blackened boiler, the axis of which coincides with this focus; a glass enclosure, which allows the solar rays to reach the boiler, but opposes their exit as soon as they have become transformed into heat-rays. The yield of a large solar heat-generator is greater than that of a small one. The whole apparatus is arranged so as to turn 15° hourly around an axle parallel to the axis of the earth, and to incline gradually to this axle, corresponding to the sun's declination. An apparatus of this kind, erected at Tours, gave the following results:—On May 8, in ordinary fine weather, 20 litres of water at 20°, introduced into the boiler at 8.30 a.m., produced in forty minutes steam at a pressure of 2 atmospheres, or a heat of 121°. This steam rapidly rose to the pressure of 5 atmospheres, a limit which it was not safe to exceed. About mid-day, with 15 litres of water in the boiler, the steam was raised in fifteen minutes from 100° to 153°—a pressure of 5 atmospheres. Hence the author concludes that in hot and sunny climates the sun's rays may be successfully utilised as a source of mechanical power.

Different Amounts of Heat Produced by the Mixture of Olive Oil with Concentrated Sulphuric Acid, according as the latter has been more or less Recently Boiled.—E. J. Maumené.—Sulphuric acid produces with certain bodies, if not with all, a disengagement of heat the greater the more recently it has been heated to its point of ebullition, 326°. It is probably the same with many bodies having, like sulphuric acid, the property of boiling at high temperatures without undergoing any chemical modification, properly so-called. These bodies,

like sulphuric acid, undergo a slight alteration in their molecular structure, the indication of which is a change in the number of calories produced by their chemical action. The author observed this fact whilst analysing samples of oil by the process which he proposed in 1852 (*Comptes Rendus*, xxxv., p. 572): 50 grms. of olive oil, mixed with 10 c.c. of *boiled* acid, gave a rise of temperature of 42°. Previously he had never employed pure acid. Latterly, the use of a sample of this acid, which had been kept for at least two months, gave 34.5° instead of 42°. The olive oil was of known origin. Being led at first to ascribe this difference to the impurities of the ordinary acid, he added ½ c.c. of nitric acid to about 50 c.c. of sulphuric acid, when, in spite of this addition, the temperature of 34.5° was reproduced. The acid used had the specific gravity 1.845. The idea of ascribing the difference to a structural modification in the boiled acid occurred then to the author, and was confirmed by experiment. Pure acid was allowed to boil, and when a few c.c. had distilled over it was tried with the same oil, and produced a rise of 44° instead of 34.5°. Twenty-four hours subsequently the result was the same. A temperature of 326°, therefore, gives sulphuric acid a structure different from that which it possesses when it has remained for some weeks at ordinary temperatures. This modification does not seem to be indicated by its physical properties. The acid in both forms possesses not a trace of rotatory power. Chemical actions alone betray this change of structure. Olive oil is not singular in this respect, the other oils presenting analogous results. Water itself appears to give rise to differences of the same kind: 50 c.c. of water, mixed with 10 c.c. of acid recently boiled, gave a rise of temperature of 35° to 36°, but only 33° with old acid.

Existence of Ferruginous and Magnetic Particles in the Atmospheric Dust.—M. G. Tissandier.—In all specimens of atmospheric dust examined by the author he has discovered minute particles of magnetic iron ore, which he believes to be of cosmic origin.

Influence of Stripping off the Leaves upon the Vegetation of the Sugar-Beet.—M. Ch. Violette.—The author finds that the result of this operation is to diminish in a notable manner both the gross yield of the crop and the proportion of sugar, and to introduce into the juice an increased amount of mineral matters and of organic substances other than sugar.

Two New Meteorites from the Desert of Atacama, with Observations on the Meteorites hitherto found in that part of South America.—M. Domeyko.—(1.) Meteoric iron from Cachiyuyal. This meteorite weighed 2.55 kilos. On analysis it yielded—

| | | | | | | | | |
|---------------|-------------------------------------|----|----|----|----|----|----|-------|
| Iron | .. | .. | .. | .. | .. | .. | .. | 93.72 |
| Nickel | .. | .. | .. | .. | .. | .. | .. | 4.81 |
| Cobalt | .. | .. | .. | .. | .. | .. | .. | 0.39 |
| Schreibersite | { 0.200 Fe 0.100 Ni 0.085 P } | | | | | | .. | 0.40 |
| Earthy matter | { 0.2 Si 0.3 MgO and CaO } | | | | | | .. | 0.50 |

99.82

(2.) Meteoric iron from Mejillones. Its composition is—

| | | | | | | | | |
|---------------|----|----|----|----|----|----|----|------|
| Iron | .. | .. | .. | .. | .. | .. | .. | 95.4 |
| Nickel | .. | .. | .. | .. | .. | .. | .. | 3.8 |
| Cobalt | .. | .. | .. | .. | .. | .. | .. | 0.1 |
| Schreibersite | .. | .. | .. | .. | .. | .. | .. | 0.9 |

100.2

M. Reimann's Farber Zeitung, No 38, 1875.

This issue contains an article on the application of eosin in dyeing, the reproduction of which is specially reserved. There are also receipts for a fine red on cotton yarn, a pale bluish green on the same material; a rose, a Nicholson-blue, and a ponceau for silk; and a deep black for woollen piece-goods.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 7, October 14, 1875.

This issue contains no chemical matter.

MEETINGS FOR THE WEEK.

MONDAY, November 1st.—Royal Institution, 2. General Monthly Meeting.

THURSDAY, 4th.—Chemical, 8. "Isomeric Terpenes and their Derivatives" (Part V.), and "On the Alkaloids contained in the Aconites" (Part I.), by G. H. Beckett and Dr. C. R. A. Wright. "A Simple Form of Gas Regulator for Maintaining a Constant Temperature in Air-Baths, Water-Baths, Incubators, &c.," by F. J. M. Page. "On the Fluorides of Arsenic Phosphorus of Iodine," by R. W. Emerson MacIvor. "On Iolyl-phenyl, a New Hydrocarbon," by Thomas Carnelly. "Ethyl-phenyl Acetyline," by T. M. Morgan. "On the Presence of Liquid Carbon Dioxide in Quartz Cavities," by W. N. Hartley.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 832.

NOTE ON THE CHANGES IN RIVER-WATERS.

By J. ALFRED WANKLYN.

I HAVE already shown that when the Nile is in high flood the proportion of chlorine is extraordinarily low, viz., 0.23 grain per gallon, the proportion of chlorine before the Nile has risen being 1.8 grains per gallon.

As I said, when publishing these results, I expected that other rivers would exhibit analogous phenomena, only that the depression would *not* be so marked. An opportunity for testing the correctness of this anticipation has been afforded by the recent floods, and at the present moment the water of the Thames, taken by the companies at Hampton Court, contains only 0.88 grain of chlorine per gallon, the usual proportion of chlorine being 1.2 grains per gallon.

ON A NEW ACID AND OXIDE OF URANIUM.

(PRELIMINARY NOTICE.)

By T. FAIRLEY, F.R.S.E.

In the course of a detailed study of oxygen compounds I have had occasion to investigate the action of hydrogen dioxide on salts of uranium. The action is remarkable, and takes place even in presence of much free acid.

On mixing solutions of uranic nitrate and hydrogen dioxide a yellowish white precipitate is obtained, which when washed and dried at 100° C. retains 1 atom of water, and gives numbers agreeing well with the empirical formula, $\text{NO}_2, \text{H}_2\text{O}$. Its real formula is no doubt some multiple of this formula. This oxide is, by its decomposition with alkaline hydrates, shown to be a compound of a higher oxide of uranium, NO_3 , with uranic oxide, N_2O_3 .

The sodium, potassium, and ammonium salts of this acid have been prepared. The sodium salt is readily obtained in crystals by mixing strong solutions of uranic salt with excess of hydrogen dioxide solution (5 per cent), and then adding strong sodium hydrate solution in quantity sufficient to dissolve the precipitate. If weaker solutions be used, the addition of a little alcohol will separate the sodium salt in crystalline plates. The full analyses of these compounds I shall publish shortly.

By means of hydrogen dioxide uranium may be separated from all other metals, and in acetic solutions either uranic salt or hydrogen dioxide may be used to titrate each other, using potassium ferrocyanide as indicator.

8, Newton Grove, Leeds,
November 1, 1875.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 203.)

IN a letter dated March 18, 1874, M. Landolt, Professor of Chemistry at the Polytechnic School of Aachen, confirms these statements. The use of water-gas is continued only in Cockerill's works at Seraing. At Simoni's cloth-works at Verviers the process never advanced beyond the stage of unsatisfactory experiments, although certain technological papers have asserted to the contrary. In Maestricht where the water-gas was used for some time for public

purposes, it has, as Professor Landolt has been informed, failed to give lasting satisfaction, and has been replaced by coal gas two years ago (1872). Direct inquiries addressed to the municipal authorities have remained unanswered.

The above statement of the introduction of the Drummond light in English military establishments led to an enquiry being addressed to the Chemist to the War Department, Mr. Abel, of Woolwich, from whom the following courteous reply was received, under date April 20, 1874: "As regards your enquiry concerning the introduction of the lime-light in military premises I have to communicate that at the period you mention experiments were made for a short time in two of our establishments, but that the question of its formal introduction has never been seriously entertained."

The illumination of the galvano-plastic works of Christoffe with water-gas was likewise of brief duration, and the process has been long ago abandoned. We are indebted to this firm for the following communication under date April 21, 1874: "In reply to your letter of the 17th we have to state that the use of hydrogen in our works came to an end in 1853 on account of certain difficulties (*inconvenients*) which presented themselves, and that we have no longer preserved the documents bearing upon the matter."

It only remained to ascertain the fate of the so-called platinum gas at Narbonne. To do this with certainty there appeared no other method than to appeal to the courtesy of the municipal authorities. The Mayor of Narbonne had the kindness to comply fully with our request, and to sign the following instructive and characteristic letter, dated March 16: "The relations of Prussia and France since the war impose upon me the greatest caution as regards inquiries. As the question, however, is one of a purely scientific nature I have handed over your letter to the Abbé Prax, chemist to the Agricultural Society of Narbonne who has for a long time occupied himself with the subject. I have the honour to enclose a copy of the memoir which he placed in my hands."

Account of the Water-gas in Narbonne from 1855 to 1865.

"In May, 1855, I was sent to Paris by the municipality to test the water-gas of Passy. My report was dated June 8, 1855. The town adopted this method of lighting and heating and came to an agreement with the company called the 'Narbonnaise.'"

"From 1856 the Passy system was in use in Narbonne. We modified the burners in several respects, as those of Passy were not sufficiently lasting. The high temperature of the retorts occasioned from time to time the loss of a furnace, and after many losses the system of retorts was abandoned in favour of another apparatus, the 'Cubilot' (Faye's apparatus). Towards the end of 1858 it was heated with wood charcoal, which soon gave place to coke on account of its costliness. At the same time we made important changes in the burners and platinum baskets, the latter of which were suspended instead of resting upon the former.

"The illumination with hydrogen is brilliant but sensitive (*délicat*). The lamps in the streets must be well closed, as a gust of wind distorts the ignited platinum wick. The dust introduces sand, which forms a silicide of platinum, and this metal ultimately assumes an injurious crystalline structure and is even partially volatilised.

"In Narbonne all care was wanting towards the end of the career of the company Narbonnaise. The manager, M. Crouzet, became a wine merchant in Paris. All superintendence was withheld, and the lighting became at last intolerable. In June, 1865, therefore, coal gas was introduced. As far as heating is concerned nothing can in my opinion compete with water-gas in convenience and cheapness."

PRAX,
Chemist to the Agricultural Society.

Narbonne, March 15, 1874.

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

ON NOCTILUCINE, THE PHOSPHORESCENT PRINCIPLE OF LUMINOUS ANIMALS.*

By Dr. T. L. PHIPSON, F.C.S.,

Member of the Chemical Society of Paris, and of the Royal Society of Medical and Natural Sciences of Brussels, &c.

IN reviewing the various phenomena of phosphorescence which are so numerous, both in the mineral world and in organic nature, it is not very difficult to convince one's self that in the great majority of well-observed cases belonging to the former, the production of light can be directly referred to electrical action, or to electrical action resulting from chemical action, and the latter mostly from oxidation.

As examples of purely electric action, may be cited the light produced in the formation and cleavage of crystals; the sparkling of boracic acid when cooling after fusion; the light emitted by benzoic acid during its sublimation; the flash of light that accompanies the cleavage of a plate of mica, when one fragment is found to be electro-positive and the other electro-negative, immediately after the operation; the light emitted when quartz pebbles are violently rubbed together, which is accompanied by an odour of ozone; the flickering scintillations observed when a mixture of sulphate of soda and sulphate of potash crystallises, when arsenious acid crystallises, when crystals of sugar or nitrate of uranium are broken, and a very great number of similar cases which it would be far too long to mention here. In fact, the more the phenomenon is observed, the more general it appears to be throughout nature.

As examples of electrical action following on chemical action, may be cited the luminosity of phosphorus, of potassium and sodium, of arsenic, sulphide of antimony, and a considerable number of cases where oxidation, or other chemical action, is intense. I have referred to all these in another place.†

In the organic world, with one exception, the luminosity of animals and certain plants can be with tolerable certainty referred to the production of the principle which I have termed noctilucine. The one exception is when the production of light can be traced also, with the greatest probability to electrical action. This is evidently the case with the sparkling radiations which are occasionally seen round the flowers of the marygold and several other plants at a certain period of their growth, when the atmospheric conditions are favourable. The phenomenon is coincident with the rupture of the anthers and the ejection of the grains of pollen. We have other examples of a similar production of light resulting from the sudden rupture of plant tissue in dry weather.

Noctilucine is a peculiar organic principle which appears to be very widely spread through nature. It is the cause of the light of the glow-worm, the scolopendra, the fireflies, the pholas, and numerous other luminous animals, both during life and for a certain time after death. The first allusion to the existence of this substance occurs in my note, "Sur la Matière Phosphorescente de la Raie," published in the *Comptes Rendus* of the Paris Academy in 1860, where I have spoken of it as a peculiar organic matter devoid of phosphorus, but shining in the dark like that element itself. It was found, by the most careful tests, to contain neither phosphorus nor phosphoric acid. It is again alluded to in my work on "Phosphorescence," published in London in 1862 (p. 103), and finally in my paper, "Sur la Noctilucine," in the *Comptes Rendus* of the Paris Academy for August 26, 1872 (p. 547). The same substance is noticed again, exactly one year later (August 25th, 1873), in the same publication, by Professor Ch. Robin and M. Laboulène.

Noctilucine is not only the cause of the phosphorescence of dead fish and animal flesh of every kind, but it is

secreted by living animals, such as the glow-worm, the scolopendra, the fireflies (*Elater*), the common earth-worm, and by a very considerable number of others, amounting probably to many hundred distinct species, that are seen to shine in the dark. It appears to be produced also by certain living plants—*Agaricus*, *Rhizomorpha*, and *Euphorbia* (?)—and occasionally in the decomposition of vegetable matter (putrid fermentation of potatoes, &c.).

At the ordinary temperature of summer in this climate, noctilucine is a fluid nitrogenous substance, slightly viscous or oily in appearance, that can be mixed with water, but does not dissolve, though the watery liquid can be filtered; its specific gravity is slightly less than that of water; its colour is white, when impure yellowish white, and when decomposed becomes brown.

When recently extracted from a living or a dead animal it invariably contains a certain quantity of water, and possesses a slight odour recalling that of caprylic acid; it is insoluble, or only slightly soluble, in alcohol and ether, but mixes with them and with glycerine. It is dissolved and easily decomposed by acids and alkalies, and when heated with potash it evolves ammonia.

Alcohol, ether, and especially mineral acids, extinguish its light very readily. When left for some days in contact with pure water, it enters into decomposition, and evolves after a time an ammoniacal odour of putrid cheese.

As long as it is moist, noctilucine absorbs oxygen and evolves carbonic acid; but, when left in the air, it dries up into thin semi-transparent films quite devoid of structure of any kind, and then resembles the substance called *mucine*, which has been obtained from garden snails and other Gasteropoda.

When recently obtained, noctilucine is highly phosphorescent, and this production of light is evidently due to oxidation in contact with the air. Numerous experiments leave me in no doubt of this. It will even shine in water when air is present in that liquid. As already stated, it is slightly soluble in water; at any rate, it mixes so intimately that the liquid, after filtration, is luminous in the dark when stirred, but as the oxidation of the noctilucine proceeds the water becomes turbid or milky and ceases to shine; it soon after enters into decomposition, evolving first an odour of propylamine, and afterwards an odour of putrid cheese.

In oxygen gas, the light emitted by noctilucine is rather more vivid than in the air, but it is more brilliant still during a south-west wind that carries much ozone. The production of light ceases when oxidation is completed, but, when the slightest quantity of air adheres to it, noctilucine will shine for a little time in moist carbonic acid.

In the heat of summer, noctilucine occasionally gets separated from the bodies, living or dead, of various marine animals, in sufficient quantity to form a thin oily stratum on the surface of the water of stagnant pools or coves on the sea coast. This oily layer gives out light when stirred so that the air can come well in contact with it, the surface being completely oxidised and having ceased to shine. Near the pier at Dover, and at the back of the port at Ostend, I have seen many square yards of water covered with this film of noctilucine in June and August; it contained few or no luminous animals, and in the evening shone when stirred. The same thin layer will form, in the course of twenty-four hours, on water in which noctilucine obtained from dead fish has been dissolved, or rather mixed; and I possess four observations of the same formation occurring upon urine. In all these cases light is emitted from the film whenever it is stirred so that it comes thoroughly in contact with the air; after repeated stirring when oxidation is completed, the light ceases to be seen.

According to some recent observations upon the fireflies of the West Indies, by Professor Charles Robin and Dr. Laboulène (*loc. cit.*) it appears very probable that noctilucine gives rise to uric acid, or urates of ammonia

* Read before the British Association for the Advancement of Science, Bristol, 1875.

† "Phosphorescence; or the Emission of Light by Minerals, Plants and Animals." London, 1862.

and soda, in its final decomposition, as these substances are invariably found in the phosphorescent organs. The characters of the luminous substance, as investigated by them in these exotic insects, correspond to those of the noctilucine extracted by me from fish, and from the glow-worm and scolopendra. These gentlemen have studied the anatomy of the luminous organs with almost as much care as Professor Paoli Panceri has studied these organs in polypes and other lower animals, in a series of remarkable papers read to the Royal Academy of Naples in 1872, and profusely illustrated.*

In phosphorescent animals noctilucine is secreted by a special organ, just as bile is secreted by the liver, and this luminous organ is as special in its character as is the electric organ of the *torpedo* or *gymnotus*. The substance is produced, and gives light, as fast as it is required. But noctilucine is also produced under certain conditions of temperature and moisture by dead animal matter, such as flesh, blood, and sometimes in urine. Whatever may be its origin, it always gives the same kind of light; the spectrum of this light really spreads from C to a little beyond F, when the phosphorescence is very vivid (as in the *Elaters* of the West Indies), but its brightest portion lies between the lines E and F, and in most cases this portion only is visible, and the light appears nearly monochromatic. It has no lines nor bands of absorption. As far as I have hitherto been able to examine it, noctilucine, whether extracted from dead fish, from the glow-worm, or the scolopendra, possesses the same chemical properties. It is secreted in a state of great purity by *Scolopendra electrica*; and in the month of September it is possible, by causing several of these myriapoda to run about on a flat glass dish with vertical slides, to collect enough of it to examine its principal characters. From the luminous organ of *Lampyrus noctiluca*, and from the surface of phosphorescent fish (stockfish, mackerel, herring, &c.), it can also be obtained, in a less pure form, by collecting on a damp filter the luminous matter washed or scraped from the surface, or, better, by stirring the shining matter with water and allowing the liquid to stand in a narrow vessel till the next day, when the noctilucine will form a layer upon the surface that can be separated; but it is already partially decomposed.

The experiments I have made with this substance for several years past, whenever I have had an opportunity of observing it, lead me to the conclusion that it is of a basic or neutral, rather than an acid, nature; and, though I have not yet obtained it either pure enough or in sufficient quantity to investigate it very minutely, I believe that noctilucine belongs to the propionic series. It may, perhaps, hereafter be proved to be a cyanic derivative of propylic aldehyd belonging to the same class of bodies as *leucine* (cyanhydric derivative of amylic aldehyd) or *creatine*. This would also tend to account for the final resolution of noctilucine into *urates* of soda and ammonia, which are almost always found in the luminous organs of various animals.

The secretion of noctilucine by the higher classes of uminous animals, such as the insects (*Elater*, *Lampyrus*, &c.) and myriapoda, is, doubtless, to a certain extent under the influence of the nervous system, which gives them the faculty of causing the light to cease. In this case the secretion is arrested for the time. (It has been long known that the eggs of the glow-worm shine for some time after they are laid, so that they also must contain a small quantity of noctilucine.)

In animals much lower down in the scale, such as the little *Noctiluca miliaris* of the English Channel, the polypes, medusæ, &c., it appears to me quite evident that there exists also a *special organ* for the production of noctilucine; and even here, where we find scarcely any indication whatever of a nervous system, the secretion of

this luminous matter often appears to be subject to external influences.

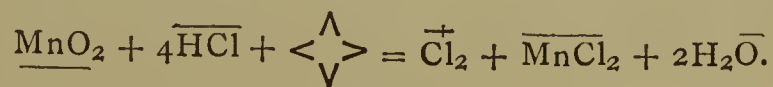
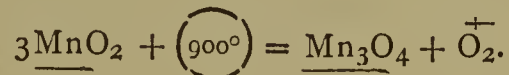
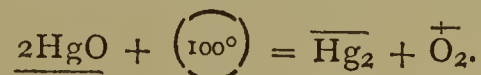
London, October 28, 1875.

ON THE
ADOPTION OF A SYMBOL TO SIGNIFY THE
APPLICATION OF HEAT FOR USE IN
EQUATIONS OF CHEMICAL REACTIONS.

By W. H. SYMONS, F.C.S., Norwich.

FOR some time past certain signs have been used in equations to show whether the substances there enumerated are in a solid, fluid, or gaseous state. Thus a short line placed above a symbol or formula indicates that the body is either a liquid or a salt in solution; a similar stroke placed below shows that it is a solid substance or an insoluble precipitate. Of course this sign must not be confounded with that which marks the abbreviated formula of a compound radical, as in this case the line is only extended over that portion of the formula which constitutes the radical. H_2O , EtHO , HA , H_3Cl , H_2T , are well known examples of this abbreviation.

The symbol I propose to use as indicatory of heat is either a star, \star or a simple cipher \circ . I think the latter to be preferred, as it is more easily written, and the degree of heat required can be placed inside. Thus—



I have used the above signs for several years, and having found them useful myself, I believe that others may do the same, and I think that any legitimate aids to memory are calculated to discourage cram.

October 7, 1875.

[Signs and symbols to be of practical use should always be capable of being expressed in ordinary printing types, otherwise there will be little chance of their general adoption.—Ed. C. N.]

A NOTE IN RELATION TO THE
MASS OF METEORIC IRON THAT FELL IN
DICKSON COUNTY, TENN., IN 1835.

By J. LAWRENCE SMITH,
Louisville, Ky.

EVERY metallic particle in the interior of a meteoric stone is a complete miniature type of the large masses of meteoric iron which have been discovered in different parts of the world, but not seen to have fallen, leading to the natural conclusion that they must have fallen at periods anterior to the date of their discovery. And it is an interesting fact in celestial meteorology, that the stony meteorites, with their little particles of metal, fall with comparative frequency. Yet the fall of iron masses free from earthy matter are so rare that we have but four authenticated cases: that of Agram, in Croatia, in May,

* The researches of these distinguished physiologists have confirmed most completely my earlier conjectures as to the special character of the luminous organs of phosphorescent animals even those lowest in the scale of animal life.

1751; that of Braunau, Bohemia, in July, 1847; that of Victoria, Africa, in 1862; and the one which now forms the subject of this communication, which fell on the 1st of August, 1835, near Charlotte, Dickson County, Tenn., U.S.; lat. $36^{\circ} 15'$, long. $87^{\circ} 22'$. A short description was given by Professor Troost, of Nashville, and published in *Am. Journ. Sci.*, 1845. Professor Troost dying very shortly after that period, his cabinet of minerals and other objects of natural history were placed in boxes by his executors, and have remained thus until within the past few months, when they passed under my control. The scientific world knowing so little of this meteoric iron, I at once proceeded to its examination; and as only a small part of one end, weighing two or three hundred grammes, had been cut off, it was easy to restore that from a drawing, and obtain a perfect cast of the mass, which had been finished in all respects to resemble the original, both in form and colour. My reason for making the present communication is to call attention to the remarkable features of this most interesting meteorite, which, although it is forty years since it fell, has not been seen by a half dozen scientific men.

This meteorite fell during the day-time, in a field where several persons were at work, frightening a horse attached to a plough, who ran wildly about the field dragging the plough after him. It struck the ground at the root of a large oak, descending at rather an acute angle, and burying itself in the roots of the tree. The sky was cloudless, and a noise was heard preceded by a vivid light. Other particulars connected with its fall, as well as a description of its size and form, have been already published by Professor Troost. It is of an elongated kidney shape and remarkably symmetrical form, the metal being bright and almost polished on many parts of the surface, and it has remained in this condition ever since it was discovered, although exposed to such atmospheric conditions as usually rust and tarnish iron; it is in this respect unique among meteoric irons, as well as in another particular first noted by Professor Troost. Although to the naked eye the surface has the appearance of smooth cast-iron, the smoothness of the surface in many parts disappears when examined through a lens; it is then seen to have a reticulated surface, formed by the edges of thin laminæ of metal, separated from each other by an apparently semi-fused or slaggy matter. These laminæ running in an inclined position into the mass, intersect one another at angles of 60° , and forming equilateral triangles, would divide the mass into regular octahedrons. The accompanying photograph from a drawing will better exhibit these lines very much magnified.

Another noteworthy fact in connection with this iron (which is soft and tough) is that, when cut and polished, it will resist the tarnishing effects of the ordinary vapours of the laboratory, as I have pieces which have been thus exposed for several months.

By the agency of heat or acid the Wiedmannstæitian figures are developed with exquisite beauty, not equalled except by three or four known meteoric irons. In connection with these figures I will call attention to the delicate parallel lines inside of these figures, which I pointed out several years ago as being peculiar to certain of the irons, they being not contained in all Wiedmannstæitian figures, and which I designate by the term "Laphamite markings."

This iron is not absolutely compact, for one can trace, even with the eye, minute cavities which are distinctly visible with a lens; but I have not yet been able to detect any schreibersite either on the surface or on the interior of the mass.

Its specific gravity is 7.717.

On analysis it was found to consist of—

| | | | | | | |
|--------|----|----|----|----|----|-------|
| Iron | .. | .. | .. | .. | .. | 91.15 |
| Nickel | .. | .. | .. | .. | .. | 8.01 |
| Cobalt | .. | .. | .. | .. | .. | 0.72 |
| Copper | .. | .. | .. | .. | .. | 0.06 |

No trace of sulphur was detected, and so minute a trace of phosphorus that only a few exceedingly small crystals of phosphate of magnesia and ammonia could be discovered in the test made with a gramme of the iron, representing only a small fraction of a milligramme of phosphorus. In fact, I have never yet analysed a meteoric iron containing so little phosphorus. In regard to the gaseous contents of this iron, the following were the results obtained by Prof. W. Wright, who made an examination of them at my request:—

"The iron being exposed to a red-heat gave a little more than twice its volume of gas. It can be estimated as 2.2, without an appreciable error. It did not appear to be given off readily, and doubtless a larger portion would have been obtained if the iron had been in a more thoroughly divided state. An analysis of the gas gave—

| | | | | | | |
|-----------------|----|----|----|----|----|-------|
| H | .. | .. | .. | .. | .. | 71.04 |
| CO | .. | .. | .. | .. | .. | 15.03 |
| CO ₂ | .. | .. | .. | .. | .. | 13.03 |

There did not appear to be any appreciable quantity of nitrogen."

It is a question of no small interest, in connection with the fall of meteoric irons, whether or not they are heated to a sufficient degree of intensity to fuse the surface of the metal. The present meteorite would appear to solve this question in the negative; for if the surface had been melted the delicate reticulated structure, which is discoverable by the glass, would have disappeared, and it would have had an irregular melted exterior. In the present case this oxide exists on the edges and between the striæ, which serves to show that the surface of the iron, although not melted, was nevertheless intensely heated, and had been preserved from fusion only by the rapid conduction of the heat from the circumference to the centre. And this should be the case with nearly all, if not all, the masses of iron which have fallen.

The Braunau iron was not near the point of fusion,—otherwise it would have set fire to the rafters of the house in which a part of it was imbedded at the time of its fall, and the surface of that iron precludes the idea of its having been fused. If this generalisation of iron be correct, it has an important bearing upon the hypothesis of the manner in which the Ovifak iron (supposing it to be meteoric) penetrated the basalt in scattered particles just at the time of the outflow of the basalt in a plastic state; for if the iron was not melted in its passage through the air, it could not have penetrated the basalt in such a manner that the particles are completely surrounded by terrestrial basalt. This fact in connection with many others lead me more and more strongly to the conviction, in common with some others, that the Ovifak iron is terrestrial.

On the whole, the iron just described is the most interesting specimen of meteoric iron yet known.

ON THE ESTIMATION OF PHOSPHORIC ACID.

By E. W. PARNELL, F.C.S.

CHEMISTS and others interested in the analysis of phosphates must, with myself, feel much indebted to Mr. Ogilvie for his elaborate and valuable series of experiments, the account of which he publishes in the *CHEMICAL NEWS*, vol. xxxi., p. 274. Mr. Ogilvie seems quite to have established the fact that accurate estimations of phosphoric acid by precipitation with magnesia cannot be effected in the presence of notable quantities of some salts of ammonia, especially the citrate and oxalate, and that even a large proportion of chloride is objectionable.

I do not, however, agree with Mr. Ogilvie in considering that it is impossible to obtain an accurate result unless a large excess of the precipitant be avoided; my experience is that the purity of the precipitated double salt depends, not on the proportion of magnesia employed, but upon the strength of the solutions and the manner in which the

precipitation is conducted. If the solutions be not too concentrated and the magnesia mixture be added slowly, with constant stirring, the analyst need never fear an excess of base carried down; on the other hand, if the reverse be the case, an impure precipitate may be obtained with only a small excess of magnesia.

The following are a series of estimations of phosphoric acid in which varying quantities of "magnesia mixture" were employed, other conditions being the same. I measured off quantities of a solution of phosphate of soda, added a small quantity of chloride of ammonium and ammonia, diluted the resulting mixture to about 100 c.c., and then dropped in slowly a measured quantity of the magnesia mixture with constant stirring. The precipitates, after standing, were filtered off over a vacuum, so as to effect the washing with a minimum amount of ammonia-water, for which I made the usual allowance. The figures under "magnesia mixture" represent the proportion to that necessary to exactly precipitate the phosphoric acid.

| Phosphate Solution. | Magnesia Mixture. | 2MgOPO ₅ . Grm. |
|---------------------|-------------------|----------------------------|
| 25 c.c. | 1.2 | 0.2021 |
| 25 " | 1.2 | 0.2024 |
| 25 " | 1.4 | 0.2030 |
| 25 " | 1.4 | 0.2023 |
| 25 " | 1.8 | 0.2022 |
| 25 " | 2.0 | 0.2025 |
| 25 " | 2.5 | 0.2025 |
| 25 " | 3.2 | 0.2021 |

The solution, before precipitation, should not contain much more than 0.1 grm. of PO₅ per 100 c.c.; and I prefer a "magnesia mixture" of such strength as would yield about 0.02 grm. of 2MgOPO₅ per c.c. I observe that Mr. Ogilvie's solution is about three times as strong as this.

NOTICES OF BOOKS.

Medical Politics, being the Essay to which was Awarded the First Carmichael Prize of £200 by the Council of the Royal College of Surgeons, Ireland. By ISAAC ASHE, M.D., &c. Dublin: Fannin and Co. London: Longmans and Co. Edinburgh: Maclachlan and Stewart.

WE have here an able suggestive essay dealing directly, it is true, with the status of an honourable profession, but having an important, though indirect, bearing upon the interests of science and the public welfare. We do not, of course, consider ourselves as in any way the organ of the medical body: but, as our readers will perceive, all Dr. Ashe's remarks on the imperfect professional organisation of medical practitioners, and its consequent evils, applies with a terrible *a fortiori* to chemists who have no organisation at all. Our author shows that among the "three learned professions" of old tradition—there have arisen other professions now not a shadow less learned—Medicine holds decidedly, in public estimation, the lowest position. In an article on this subject in the *Athenæum*, in August, 1868, the remark is made that "the difference in position between the well-beneficed rector and the country practitioner is so great that there is really no comparison between them." This, Dr. Ashe justly observes, "states things as they are, not as they ought to be." "We have known," he adds, "the major of a militia regiment, a man who prided himself on belonging to one of the county families, and who had been high sheriff of his county, give a physician the fee of £1 for five visits, during which his child's life had been saved, and which had cost the doctor, in actual cash out of pocket, the sum of 15s. . . . We have known, in the same district, a lady of title employ a physician to attend her family, sending for him in much consternation, and with great urgency, and when the attendance was over bow him out without any fee whatever, and never send him any afterwards, as he might suppose she meant to do. But what

redress has he? To appeal to a court of law, as things are at present, would drive him out of the county. Nor is this estimate of the value of medical services confined to the country districts, or to the sick public only. The fee allowed to a physician by the legal functionaries for spending his whole day in a court of law, whether at Quarter Sessions or Assizes, is just one guinea. If he lives at such a distance as to preclude his returning the same night, he may claim a second to cover hotel charges, &c., but if living in the town, one guinea is the whole sum for the entire time. It signifies nothing what his other practice may be, nor how much he may lose meantime; and we have known a man permanently lose the practice of a family through his being detained at a distance in a court of law."

Surely such facts need no comment. But more remains. "In the case of a physician who has to undertake a dispensary we must add to such social slights the petty insolence of the village publican who writes P.L.G. after his name with as much pride as if it were K.G., and takes upon himself to belabour the doctor with insolence about his cases if he meets him upon the road; the orders of the parish administrator or his curate, who are not even guardians, or on the dispensary committee, but who know that the doctor dare not reply to them under penalty of dismissal from his post; the difficulties even with the relieving officer, who will venture to dispute the doctor's diagnosis of a case, as in an instance which lately obtained some notoriety." This is certainly a disgusting picture. We fear "Bumbledom" is even more rampant in Ireland than in England, though we must never forget that we have in this country one rural P.L.G., and M.P. to boot, who conceives it his especial mission to adjudicate on the "competence" of Public Analysts.

For the evils glanced at above Dr. Ashe proposes the adoption of a more perfect organisation, and the limitation of the numbers of the profession. At the same time, with a somewhat questionable consistency, he rather favours the modern notion of "medical women." Now, save in such very exceptional spheres as the higher grades of literature, the fine arts, and the stage, wherever female labour has been introduced one of its most striking consequences has been a decline both in the amount of remuneration, and in the *status* of the calling.

We cannot help asking what would Dr. Ashe say if medical men had to encounter the competition, not merely of those who accept under-paid appointments, but of such as offer to undertake such appointments without any remuneration at all? What would he say if the physician were not merely dictated to and interfered with, but if the members of other professions sought to encroach upon his sphere of action? Yet such, and no other, is the present position of the "analytical and consulting chemist."

Dr. Ashe's essay is worth the heedful perusal of many besides medical men.

CORRESPONDENCE.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE ESTIMATION OF POTASH AND PHOSPHATES.

To the Editor of the Chemical News.

SIR,—In CHEMICAL NEWS, vol. xxxii., p. 192, "Chemicus" waxes wrath in the matter of the "well-known firm of chemists" who refused to give any information to the British Association Committee. I am afraid "Chemicus" has hitherto looked upon this and kindred matters in a wrong light, and has also taken a very narrow-minded view of the subject. It is, no doubt, very laudable and praiseworthy for scientific men to give their services, their time, and their brains to those who have been found trustworthy and willing to work and co-operate in scientific

matters, and in matters of pure science there is, I think, no one who would object to this. In determining the true atomic weight of the elements, the coefficients of expansion of liquids, the solubilities of various salts, the specific heats of gases and vapours, the examination of new forces; these are matters upon which men of science do freely interchange their views. But there is a dearth of workers in these fields; for it is well known that such work does not bring grist to the mill, at least to many.

When we come to the subject of analytical chemistry, it is a different matter; those who pursue this branch for the love of the thing generally submit all processes used to a most searching examination before they are used, and those analysts who care for a reputation generally do the same thing.

Now, I ask "Chemicus," do *all* the present analytical chemists submit the processes they use to this rigorous examination? Do they all care about using pure chemicals? Or, how many of them know all the peculiarities of the substances upon which they operate? It is not so much a faulty method of analysis which causes the discrepancies between analysts, but rapid and rule-of-thumb working and a principle of don't care, as long as the fees come rolling in.

It is still in the remembrance of a few how two analysts differed 3 per cent in a sulphur estimation in pyrites; how a sample of soda-ash of 47 per cent was certificated 50 per cent by a firm of analysts in a western port of England: how the same firm certificated a sample of bleaching-powder as 33.5 per cent, when it really contained over 35 per cent; how one analyst found 3.06 per cent of lime in a phosphatic material when it contained 33.6 per cent; how another actually forwarded by post a certificate of the strength of a sample of salt-cake before he actually received the sample; how a Public Analyst found 30 per cent of roasted acorns in coffee, and then excused himself that his apparatus (*sic*) for this particular estimation was out of order; and it is also to be remembered how a Professor in a College will undertake the estimation of chlorine in bleaching-powder for a shilling per sample if a sufficient number be sent at once. This is trading with a vengeance—small profits and quick returns. How another will make a partial analysis of soda-ash, viz., a determination of the alkali and caustic, for half-a-crown; how a druggist's apprentice issued a list of fees in a town near Birmingham, he never having made a quantitative analysis before this and having at the time no apparatus to work with. But enough of this. Can "Chemicus" expect real analysts to work for the possible benefit of such men as these? No. The profession of the analytical chemist is rapidly deteriorating, and the practice of making a process easily workable by "unpractised persons" is beginning to exert its deleterious influences.

We are too fond of making mechanical chemists chemists, or rather without thought and judgment.

The general plan seems now to be to set down a process according to an invariable rule, and put this into the hands of "unpractised persons," saying, thus far shalt thou go and no farther. This unpractised machine may run on until some variation is required in the ordinary manipulation. But then does it break down? Oh, no! not till it has broken down something else, like a locomotive or a coach once in motion and without a driver.

We have high and low analysts; analysts weighing impure precipitates, while others are leaving that in solution they ought to weigh; some giving false certificates, others giving certificates on samples never examined at all; some detect alum in bread where alum there was none; and another possesses an apparatus for detecting roasted acorns. In fact, a general muddle is made, but with those who are conscientious and take care to rigidly examine every process they use.

The number of analytic chemists is enormously on the increase; and, taking the case of private practices, this really means less individual work and lower fees than formerly. It cannot be done, Sir; it cannot be done.

Rapidity and accuracy do not generally go together; and, what with the fees in some districts being so low, a practice cannot afford time for investigation or to pay an investigator.

Can we expect *real* chemists to give the information they have obtained at the expense of time, labour, brains, and money, at least willingly, to those who have helped to bring down the profession to such a low ebb as it is now at.

I think the reply of the "well-known firm of chemists" a very reasonable one; and, although I am always ready to help a deserving lame dog over a stile as far as it lies in my power, yet there are many clumsy and unscrupulous fellows who would get no assistance from me, as also from many others of my way of thinking.

Has "Chemicus" anything to publish on analytical work? Those who are on the look out for information would, doubtless, be glad to see it. I shall be glad to hear that "Chemicus" has published any researches on analytical work: or is he only thirsting for information, he being one of those who have not yet perfected their processes?

The world, as a rule, esteems not those who give their services so free—people do not believe in such universal philanthropy; and, as to exchange of views in matters relating to pure science, let "Chemicus" reflect, and remember that, after all, it is not pure science, but money-making, which is the chief object of analytical chemistry, including the estimation of potash salts and phosphates.—I am, &c.,

XYLO.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I cannot agree with Mr. Esilman in thinking that his process of converting sulphocyanide of ammonium into the sulphate of ammonia "is an easy and inexpensive method." I look upon it as a wasteful, dangerous, and expensive process, for every ton of the sulphocyanide would require nearly 1 ton of acid at 110° Tw.; for in some cases the percentage of sulphocyanide is more than the sulphate, as, for instance, in a case which I have just had myself, where the sulphocyanide was 91 per cent: to convert this into sulphate we should require nearly £200 worth of sulphuric acid, and then only make about 79 tons of sulphate of ammonia, whereas if the sample were distilled with hydrate of lime we should obtain about 158 tons.—I am, &c.,

J. CARTER BELL.

20, East Corridor,
59, Mark Lane, London.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As a sulphate with 24 per cent of ammonia, and of a "good grey" colour, but containing a considerable proportion of sulphocyanide, can be made with facility from the "spent oxide of the gas works, it becomes important to know what is the real influence of sulphocyanogen compounds upon the farmer's crop.

The Consulting Chemist of the Royal Agricultural Society, in his Report for 1873, referring to the sulphate produced from this material, says that he finds most of the samples "contain appreciable quantities of sulphocyanide of ammonium—a salt which exerts a most pernicious influence upon vegetation, even if it is applied to the land in very small quantities." He adds—"Some preliminary experiments which I have made, with the view of testing practically the effects of sulphocyanide of ammonium upon plants, have shown me that it is the most powerful poison to wheat, barley, and cereal crops with which I am acquainted; and I am inclined to think that as little as 10 lbs. per acre of sulphocyanide of ammonium,

in a top-dressing of sulphate of ammonia, will injuriously affect the young barley or wheat crop. The same and similar poisonous cyanogen compounds occur not unfrequently in gas-lime and other refuse materials obtained from gas works, and used occasionally for manuring purposes. To my knowledge great mischief sometimes is done by applying certain refuse materials from gas works to grass land; and I am inclined to think that the cause of the mischief may be traced—in perhaps not a few cases—to the cyanogen compounds which occur in some refuse materials from gas works. I would therefore recommend great caution in the application to the land of waste products from gas works, and suggest that such products should be carefully examined for cyanogen compounds before they are used for manuring purposes.”—I am, &c.,

A. ESILMAN.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—I have only just read Mr. Davis's interesting articles on the “Manufacture of White Caustic Soda,” and should feel much obliged to him if he would, through the medium of your valuable journal, state whether the “lime mud” he mentions, in connection with the causticising operation, is used in the black-ash mixture in its moist state, or whether it is first dried. If the former, whether the moisture it contains does not so reduce the temperature of the furnace that the cost of the extra slack necessary to overcome that reduction does not neutralise the economy of using the lime mud? I should also be glad to hear from Mr. Davis whether, in his experience, he has found that the furnace-men are willing to work a large proportion of lime mud in a charge at the same rate of wages that they will work limestone?—I am, &c.,

ENQUIRER.

November 2, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—I have read with much interest the admirable articles published in your journal on the “Manufacture of White Caustic Soda,” by Mr. G. E. Davis. For the valuable information contained in them I am sure I am much indebted to him. Now I wish to ask a question relating to the way in which some of the analytical results placed so fully before us were obtained; and this not only for my own information, but for that of other chemists also who may be at a similar loss. Would Mr. Davis inform us what process he used for the separate estimations of all the sulphur compounds in some of his very elaborate analyses—say the analysis of the red liquors from the black-ash pans (CHEM. NEWS, vol. xxxii., p. 212). How was a polysulphide of sodium estimated in the presence of such an enormous excess of sodium hydrate? How were the bisulphide, sulphide, sulphite, hyposulphite, and sulphate severally estimated? And, lastly, how were the cyanogen compounds determined? I have been quite unable to obtain information upon a method for the estimation of *all* these compounds in presence of each other, and any hints upon the subject of this by no means easy chemical problem would much oblige.—I am, &c.,

G. P.

Liverpool, November 2, 1875.

THE MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The Mineralogical Society of Great Britain and Ireland now numbers sixty members, and includes five Fellows of the Royal Society, thirty of the Geological, twelve of the Chemical, &c., besides representatives of the Geological Societies of Edinburgh, Glasgow, Dublin,

&c. New names are coming in every day—mostly, I believe of real workers in some branch of the science. London and its neighbourhood is represented by fifteen members, Cornwall and Devon by thirteen, the North of England by eight, &c., so that there will be no difficulty in forming local sections for mineralogical work.

A General Meeting will be called very shortly, for final adoption of Rules, &c. In the meantime I shall be glad to hear from gentlemen who may be desirous of obtaining information as to the objects, &c., of the Society.—I am, &c.,

J. H. COLLINS, Sec. *pro tem*.

Truro, October 30, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

SIR,—I shall be greatly obliged if any of your readers will inform me, through your journal, what substances other than the minerals albite, axinite, Labradorite, and oligoclase they have observed to crystallise in any of the following forms, viz.—The oblique spheroid, the doubly-oblique spheroid, the doubly-oblique rectangular prism and pyramid, and the doubly-oblique rhombic prism and pyramid.—I am, &c.,

T. A. READWIN.

Liverpool, November 1, 1875.

NOTES UPON SUGAR ANALYSIS.

To the Editor of the Chemical News.

SIR,—In a letter signed “Beet” (CHEM. NEWS, vol. xxxii., p. 145) attention has been drawn to the remarkable similarity, and even identity, both in idea and expression, between Mr. Stewart's paper on “Sugar Analysis” (CHEM. NEWS, vol. xxxi., pp. 212 and 223) and papers written by other writers upon the same subject who wrote prior to Mr. Stewart. I have also observed this similarity, and, as an example, I enclose extracts from a paper by Dr. Wallace, written in 1869 (*Journ. Chem. Soc.*, new series, vol. vii., p. 100), and, side by side, extracts from Mr. Stewart's paper; and it will be seen at a glance that both columns are almost identical.

No answer has yet appeared to the letter signed “Beet,” although more than a month has now passed since that letter was written. I think it right that Mr. Stewart should satisfy persons who are interested in this question as to whether this similarity is accidental or otherwise.—I am, &c.,

CANE.

October 26, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 15, October 11, 1875.

Rotatory Polarisation of Quartz.—J. L. Soret and E. Sarazin.—Not adapted for abstraction.

New Note on Processes of Magnetisation.—M. J. M. Gauguain.—After the removal of the magnets, the magnetisation of the middle portion of the bar is weakened in case of perpendicular magnets by the reaction of the parts lying beyond the points of contact. On the contrary, in the case of oblique magnets, the magnetisation of the middle part is strengthened by the reaction of all the other adjacent parts. Hence we may conceive that the inclination of the magnets may increase the permanent magnetisation of the middle part of the bar, although decreasing its temporary magnetisation.

Researches on the Ammonia Contained in Sea-Waters, and in those of the Salt-Marshes of the District of Montpellier.—M. Audouy.—The author has made use of a standard solution of oxalic acid, of which 10 c.c. were saturated by 1.7 milligram. of ammonia. The alkaline liquid was a dilute solution of potassa. He found in the sea-water amounts of ammonia, capable of being driven off by magnesia, varying from 0.16 milligram. to 1.22 milligram. per litre. But sea-water contains no ammonia in a volatile state, and consequently does not exhale any. The water of the salt-marshes gave amounts of ammonia varying from 0.00 to 0.81 milligram. per litre.

Commercial Analysis of Sugars, and on the Influence of Salts and of Glucose on the Crystallisation of Sugar.—M. Durin.—In the commercial analysis of sugars it is not sufficient to determine the mere quantity of pure sugar present. It is needful also to know the amount of certain foreign bodies which have the power of interfering with the crystallisation of sugar in the process of refining. Salts hinder crystallisation to the extent of four or five times their own weight. Glucose has also been considered as obstructive to the extent of twice its weight. The author finds that crystallisable salts do not interfere with the crystallisation of the sugar, but that the formation of treacle is due to organic matters and deliquescent salts present in the juice of the cane and the beet. Nevertheless, the assumption that each part of saline matter will hinder the crystallisation of 4 parts of sugar, though it is founded on a theoretical error, gives results satisfactory in industrial practice. Glucose, contrary to the usual opinion, does not interfere with crystallisation.

Electro-Conductibility of Pyrites.—M. H. Duffet.—The author contends that the conductivity of iron pyrites is a true metallic conductivity, very variable according to the physical structure of the specimen, but which, in a given crystal, is affected neither by the direction, nor the intensity, nor the duration of the current.

Telluric Minerals Recently Discovered in Chili.—M. Domeyko.—Tellurium has been found in Chili in at least two forms. Telluric silver (bessite) is found, containing—

| | I. | II. |
|-------------------|-------|-------|
| Tellurium | 37.6 | 38.0 |
| Silver | 58.0 | 56.6 |
| Lead | 4.7 | 5.4 |
| | 100.3 | 100.0 |

This mineral is auriferous, but the proportion of gold does not exceed 0.00025. It is found in grains weighing from 3 to 5 decigrammes, of a blackish steel-grey, very fusible, and readily attacked by nitric acid. Tellurate of lead is recognised by its beautiful light yellow colour.

Central-Blatt für Agrikultur Chemie,
Heft 7, July, 1875.

Amount of Ammonia in the Atmosphere.—A. Lévy and H. M. Davy.—The ammonia contained in the rain-water was found to amount annually to 13.483 kilos. per hectare of land. To this must be added a somewhat smaller quantity of nitric or nitrous acid. Nevertheless the total amount of combined nitrogen per hectare is small, and does not suffice to explain the excess of nitrogen withdrawn by certain crops from the soil.

Comparative Temperatures during Frost Beneath a Soil Covered with Turf and a Bare Soil.—M. Becquerel and E. Becquerel.—The temperature of the air during these observations ranged from 0° to -12°. That beneath the ground covered with turf never sank as low as 0°, whilst that beneath bare ground fell to -5°.

Weathering of the Soil under various External Influences.—Dr. Th. Dietrich.—The author examines the action of the atmosphere, of ammoniacal salts, of cultivated plants upon different soils, and upon the geological formations from whose decay the soils have

originated. Among the ammoniacal salts the chloride was the most energetic, as it increased the solvent power of water twenty-five times. The sulphate of ammonia, however, rendered the greatest proportion of potash soluble.

Contributions to the Absorption-Phenomena of Arable Soils.—Prof. Eichhorn.—The author, carrying out the ideas of Way, has examined the power of certain natural hydrated double silicates in absorbing saline solutions. His main results are that the hydrous double silicates of alumina and lime—*e.g.*, chabasit and stilbite—absorb ammonia from solutions of ammonium chloride and phosphate very readily. Anhydrous double silicates not decomposed by hydrochloric acid, such as felspar, do not absorb ammonia. Silicates decomposable by hydrochloric acid, such as leucite and blast-furnace slag, take up a more considerable amount.

Use of Potassic Saline Manures, especially the Kainite of Leopoldshall.—Dr. P. Wagner.—Potash applied to the soil in the form of crude kainite is diffused more equally and further in the soil than pure salts of potash.

Yearly Requirement of Mineral Matter for an Acre of Ground Planted with Riesling Vines.—Prof. C. Neubauer.—The author gives analyses of the different parts of the vine, of the vine itself, and the lees, and from the average proportions of these deduces the amount of mineral matter to be supplied.

Cultural Experiment with Different Seeds of Sugar-Beet, with Examination of the Yield.—Professors Drechsler and Tollens.—In this experiment the "Schlieckmann" variety yielded the largest gross crop, the greatest proportion of sugar, and the smallest of other matters.

Contributions to the Knowledge of the Physical Properties of Milk.—Dr. W. Fleischmann.—The author determines the specific heat of milk.

The Albumenoid Bodies of Milk.—F. Selmi.—The author did not succeed in detecting the "lacto-protein" of Millon and Commaille, nor the albumenoid body which these chemists precipitate with the sulphate of mercury.

Properties and Preparation of Rennet.—Olof Hammersten.

Saccharomyces Cerevisiæ and Free Oxygen.—Prof. A. Meyer.—The author does not consider Brefeld's experiments sufficient to prove that respiring and germinating yeast cells are incapable of setting up alcoholic fermentation.

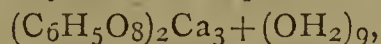
Production of Low Organisms in Liquids Free from Germs.—Onimus.—The author concludes that the lower cryptogamous organisms, the bacteria, arise spontaneously, and develop themselves in albumenoid liquids in the absence of air.

Justus Liebig's Annalen der Chemie,
October 6, 1875.

Dissociation of Salts containing Water.—H. Precht and K. Kraut.—The authors consider the dissociation-heat of a salt containing water to be an interval between two temperatures, the lower of which is marked by the commencement of the loss of water, and the upper is reached when the salt has become anhydrous, and the tension of the vapour it has yielded is equal to that of free steam. It is assumed that during the dehydration of a salt within the dissociation temperature a mutual reaction arises between the partially dehydrated salt and the escaped water, which prevents the further loss of water, or produces an equilibrium. For every given size of the vacuum, and for every quantity of the salt, the upper boundary of the dissociation-temperature is different; and the curve representing the mutual action varies in its form. At a given temperature, and with a limited vacuum, the tension of an aqueous salt depends upon its quantity. With the quantity the tension increases, and approaches a limit which, within the temperature of dissociation, is probably

only reached in case of an infinite quantity. If, on the other hand, the temperature and the quantity of the salt are constant, the size of the vacuum determines the attainable tension. A small vacuum determines a higher tension, a large vacuum a lower tension—a proposition which follows, indeed, from the former. The authors then describe the apparatus employed, which cannot be understood without the accompanying figures, and give the detailed results of their experiments on gypsum, sulphate of cadmium, ferrous sulphate, ammonio-ferrous sulphate, ammonia- and potash-alum, and carbonate of soda.

Substitution-Products of Citric Acid, and an Attempt at its Synthesis.—Dr. B. Pawolleck.—The author describes oxy-citrates of potash, soda, lime,—



baryta, cadmium, copper, zinc, and ethyl. He attempted to replace the chlorine in mono-chloro-citric acid by hydrogen, but without success.

Synthesis of Sulphuretted Tannins.—Hugo Schiff.—The author considers pure tannin free from sugar as an ethereal anhydride of 2 molecules of gallic acid. He endeavoured to ascertain in how far aromatic oxysulph-acids are analogous in their behaviour to the corresponding carbon acids. During this investigation he discovered a class of sulphuretted compounds, possessing almost all the attributes of tannin. Among these are phenol-sulph-acid anhydride, tri-chlor-hydro-chinon-sulph-acid, pyro-gallol-sulph-acid, sulpho-tannic acid, sulpho-gallic acid, pentacetyl-sulpho-tannic acid, and sulpho-acids of phloroglucin.

On Lievrite.—L. Sipööz.—The analyses of lievrite have been somewhat discordant, especially as regards the presence or absence of water. The author having obtained some well-crystallised specimens from Elba undertook several analyses, and found its average composition—

| | |
|-------------------------|-------|
| Silica | 29.67 |
| Ferric oxide | 21.26 |
| Ferrous oxide | 33.09 |
| Manganous oxide | 0.74 |
| Lime | 13.33 |
| Water | 2.32 |

100.41

Dimethyl-Parabanic Acid and Succid-Cyanic Ether.—M. Menshutkin.—In addition to the two compounds named in the title the author describes ethyl-succinuric acid and succid-cyan-methylic ether.

Amidoid Derivatives of Hydroxylamin, Cinnam-hydroxamic Acid, and Dicinnam-hydroxamic Acid.—Dr. E. Rostoski.—The author describes the preparation of these compounds, and the cinnam-hydroxamates of potash, $N(C_9H_7O)HKO + N(C_9H_7O)H_2O$, of soda, baryta, lead; the distillation of cinnam-hydroxamate of baryta; dicinnam-hydroxamic acid, $N(C_9H_7O_2)HO$, and its potash, soda, lead, and silver salts, and its decompositions. Dr. Rostoski finds that cinnamic acid forms hydroxylamin derivatives, which have essentially the character of the known hydroxamic acids. The transformations of cinnam-hydroxamic acids are less simple than those of the other hydroxamic acids, and possibly take a different direction.

Isomeric Tri-benz-hydroxylamines.—Dr. A. Steiner.—Not suitable for abstraction.

On Opianin.—O. Hesse.—The author proves that opianin is simply pure nicotin. The distinctions found by Hinterberger may be traced to his having compared it with an impure sample of narcotin.

Chinicin and Cinchonin.—O. Hesse.—A lengthy paper of great interest, but not fit for abstraction.

Glycogen and Glycocol in the Muscular Tissue of Pecten Irradians.—N. H. Chittenden.

Researches on Para-Sulpho-Benzoic Acid.—Ira Remsen.—The author examines the formation of para-

oxy-benzoic acid from sulpho-benzoic acid, and treats of para-sulpho-benzoic acid as an ingredient of crude sulpho-benzoic acid; the formation of para-sulpho-benzoic acid from sulpho-toluic acid; para-sulpho-benzoic acid and its salts; nitro-para-sulpho-benzoic acid; the formation of terephthalic acid from para-sulpho-benzoic acid; attempts at the preparation of ortho-sulpho-benzoic acid; the oxidation of the amides of sulpho-toluic acid, which yields para-sulph-amin-benzoic acid.

Communications from the University Laboratory of Halle.—These communications consist of a paper on "Triacetamin and Certain of its Salts;" one on a "Fourth Aceton Base, Iso-triaceton-amin;" and one on "Diaceton Alcohol," all by W. Heintz.

Gas Given Off by Apples.—C. Bender.—The gas, very carefully collected, was found to consist of—

| | |
|-----------------------|-------|
| Carbonic acid | 40.20 |
| Oxygen | 0.43 |
| Nitrogen | 59.37 |

The oxygen is probably an impurity.

Gas from the Capsules of Colutea Arborescens.—C. Bender.—The gaseous mixture consisted of—

| | |
|-----------------------|------|
| Carbonic acid | 2.2 |
| Oxygen | 18.7 |
| Nitrogen | 79.1 |

100.0

Improved Balance with Aluminium Beams.—F. Frerichs.—This paper requires the accompanying illustration.

Distillation of Stilben, and on the Secondary Products then Produced.—Dr. Carl Forst.—In this paper we find a description of the action of heat on benzyl-sulphide; an account of toallyl-sulphide; the action of heat upon barium-phenyl-acetate in presence of sulphur; and the preparation of stilben from toluol.

Aërial Checking for Analytical Balances.—Prof. Erzberger.—A description of a very ingenious contrivance for reducing the vibration of the balance in delicate operations. The mechanism cannot be intelligibly described without the accompanying figure.

MISCELLANEOUS.

Metropolitan Gas.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the City authorities and to the Metropolitan Board of Works the results of the daily testings of the gas supplied to London by the Chartered, the Imperial, and the South Metropolitan Gas Companies during the last three months. The illuminating power, he states, has been ascertained by burning the gas at the rate of five an hour from a Sugg's London argand, in the case of the common gas, and from a bat's-wing burner in the case of cannel gas. The results at the nine testing places have been as follows:—Chartered gas: Beckton, equal to 17.88 standard sperm candles; at Friendly Place, 16.45 candles; and at Ladbroke Grove, 16.88 candles. Imperial gas: Carlyle Square, 16.92 candles; Camden Street, 16.19 candles; Graham Road, 16.87 candles; and Bruce Terrace, 16.11 candles. The South Metropolitan gas, 16.12 candles; and the cannel gas of the Chartered Company, 21.41 candles. These results show that the illuminating power of the gas has been above the requirements of the Acts of Parliament. As regards impurity, Dr. Letheby reports that the Chartered gas at Beckton contained traces of sulphuretted hydrogen on eight occasions, but at all other stations the gas was quite free from this impurity. The average proportions of sulphur in the gas were 11.32 grains per 100 cubic feet at Beckton, 8.92 grains at Friendly Place, 11.77 grains at Ladbroke Grove, 9.24 grains at Millbank, 16.13 grains at Carlyle Square, 11.73 grains at Camden Street, 7.61 grains at Graham Road, 10.48 grains at Bruce

Terrace, and 13.61 grains at Hill Street, Peckham. On one occasion at Beckton, and on two occasions at Bruce Terrace, the gas contained an excess of sulphur (over 15 grains per 100 feet); and on two occasions at Hill Street the proportions of sulphur exceeded 20 grains per 100 feet. The cause of this excess in the gas at Beckton and at Bruce Terrace, as well as the presence of sulphuretted hydrogen in the Beckton gas, has been the subject of investigation, and Dr. Letheby finds that it was due to accidental circumstances. The proportion of ammonia in the gas has never reached the prescribed amount of 2.5 grains per 100 feet, the averages at the several testing places being from 0.02 of a grain to 1.47 grains per 100 feet.

Underground Waters in the New Red Sandstone and Permian Formations of England.—At the Bristol Meeting of the British Association for the Advancement of Science Mr. C. E. De Rance, F.G.S., read an abstract of the preliminary report of the Committee appointed last year, with Professor Hull, F.R.S., as chairman, and Mr. De Rance, as Secretary, "for the purpose of investigating the underground waters in the New Red Sandstone and Permian formations of England, and the quality and character of the water supplied to various towns and districts from these formations." As regards *quantity* the report states that in the Nottingham district the Bestwood pumping station yields more than $3\frac{1}{2}$ million gallons per day from the Pebble Beds, the supply of water from which, as proved by colliery operations in the Newstead area, is practically inexhaustible. The Wall-grange springs, near Leek, in Staffordshire, in the same formation, supplying the Potteries' waterworks, also yield 3 million gallons daily; and in Liverpool and in Manchester the New Red Sandstone yields more than 6 million gallons per day to the various wells of those districts. Plentiful supplies are yielded by wells in the south-west of England, reported on by Messrs. Pengelly and Moore, at Maidencombe, near Torquay Teignmouth, Tiverton, Dawlish, Bramford, Speke, near Exeter Taunton, Wellington, and Wembdon. In the Midland counties, at Leicester, Nuneaton (250,000 gallons), Coventry (well entirely in the Permian, yielding 350 gallons per minute), Hinckley, Elmsthorpe, and Hathern, where the water rose 50 feet into the air from the Lower Keuper Sandstone. Good supplies of moderately hard water are supplied by New Red wells, to Southport, Birkenhead, Ormskirk, St. Helen's, Ince, and a large number of other towns in Lancashire. The available area in England of water-bearing New Red and Permian formations is much larger than the actual outcrop of these rocks as shown on the geological maps, there being extensive tracts of Lias and other newer formations that can be easily penetrated, and a supply of water obtained as at Scarle, in Lincolnshire, where a bore-hole of 4 inches penetrated the Lias and Keuper Marls, and struck in the Lower Keuper Sandstone a feeder of water, which rose to the surface and yielded 11 gallons. Below this feeder, which occurred at 790 feet, another was struck at 950, which yielded a much larger supply. With regard to the *quality* of the waters the various analyses obtained place the New Red and Permian waters in an intermediate position between the hard waters of the mountain limestone and chalk and the soft waters of the Palæozoic rocks. In the water obtained from a well at Whitmore, near Crewe, the site of which was chosen by Professor Hull, only 6.10 grains of solid matter occur, and in another of the London and North-Western Railway wells, that of Parkside, near Warrington, only 11.12 grains of solid matter per gallon occur, the degree of hardness being 4.1 after boiling. The water is stated by Mr. Ramsbottom, the Superintendent of the Locomotive Department of that railway, to be the best for engine boilers, of all the waters obtained on the Company's system. Mr. Plant reports the Permian water of Leicestershire as soft, the water from the Bunter New Red beds as nearly soft, and those from the Keuper Sandstone as hard, containing carbonate and sulphate of

lime. It is the presence of the last ingredient in the water used in brewing at Burton-on-Trent, by Messrs. Bass, Allsopp, Salt, and other firms, which is believed to give the Burton water its special pre-eminence in the manufacture of beer. Mr. Molyneux believes the large amount of calcareous ingredients here met with (70 grains in an imperial gallon) to be due to the water dissolving all the gypsum of the Keuper Marls of Needwood Forest, from whence it flows down the dip planes of the strata to the Burton-valley fault, up which it rises, and is tapped by the artesian borings of the breweries. Some of the wells close to the Mersey, at Liverpool, show examples of very hard water, and are daily becoming more so, through the percolation of salt water, induced by pumping inland; but this in no way affects the large wells used by the Corporation for water supply further from the river.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 833.

ANALYSIS OF GRAPHITE FROM SIBERIA.

By SERGIUS KERN, St. Petersburg.

HAVING lately analysed two samples of Siberian graphite from the Stepanovsky mine, I think the results of the analyses may be of some use. The Zeilon graphite containing 80 per cent of carbon and coming from England to Russia is far richer and cleaner, and mixed with Russian graphite is used for the manufacture of black-lead crucibles.

Analyses of Stepanovsky Graphite.

| | Samples | |
|-----------------------|---------------------|----------------------|
| | No. I. Per cent. | No. II. Per cent. |
| Carbon | 36.06 | 33.20 |
| Silica | 37.72 | 43.20 |
| Ferric oxide.. .. | 4.02 | 3.05 |
| Alumina | 17.80 | 15.42 |
| Lime } | 1.20 | 1.06 |
| Magnesia } | | |
| Volatile matter | 3.20 | 4.03 |
| Sulphur | traces | 0.04 |
| | 100.00 | 100.00 |

ON THE DECOMPOSITION OF THE TRICHLORIDES OF ANTIMONY AND BISMUTH.

By R. W. EMERSON MACIVOR, F.C.S.

WHILE preparing a hydrochloric acid solution of antimony trichloride for laboratory use, I made an interesting observation regarding its decomposition by water, which, so far as I can learn, is not noticed in chemical handbooks. If the hot, somewhat concentrated, solution of trichloride is diluted with boiling water until a faint, permanent turbidity, due to the precipitation of antimonious oxychloride, is produced, and, after the addition of a drop or two of strong hydrochloric acid to dissolve the turbidity, allowed to cool, it will become converted into an almost solid mass of amorphous oxychloride, which, on heating to about 100° C., re-dissolves, producing a perfectly clear solution, from which, on cooling, the oxychloride again separates. A quantity of the precipitate was collected, dried, digested, and thoroughly washed with carbon disulphide, and submitted to analysis, when it was found to have the following centesimal composition:—

| | |
|-------------------------|--------|
| Sb | 76.19 |
| Cl | 11.32 |
| O (as difference) | 12.49 |
| | 100.00 |

These numbers correspond very well with those required by Sabanejeff's oxychloride, $\text{Sb}_4\text{Cl}_2\text{O}_5$ or $2\text{SbCl}_3 \cdot 5\text{Sb}_2\text{O}_3$:—

| | |
|-----------------------|--------|
| Sb_4 | 76.37 |
| Cl_2 | 11.11 |
| O_5 | 12.52 |
| | 100.00 |

When hot concentrated hydrochloric acid is saturated with antimonious oxychloride, $\text{Sb}_4\text{Cl}_2\text{O}_5$, and the solution cooled, an oxychloride containing less chlorine than the original compound is precipitated.

When a hot concentrated solution of bismuth chloride

is diluted with boiling water until a slight permanent precipitate of oxychloride is formed, and then permitted to cool down, little or no oxychloride separates.

Scientific Chemical Laboratory,
Andersonian University, Glasgow.

THE PRINCIPLES ON WHICH LEGISLATION RESPECTING THE POLLUTION OF RIVERS SHOULD BE BASED.*

By Dr. CORNELIUS FOX,
Health Officer of East, Central, and South Essex.

So much has been written and spoken relative to the great question of the pollution of rivers that the minds of legislators and scientific men must be wearied with the whole subject. That the people of this country think it a very important one, and desire earnestly that some satisfactory settlement may soon be arrived at cannot be doubted. To many it is a question fraught with danger to trade and therefore to be opposed in every shape and form. And yet every one who has ever thought on the matter would, I believe, freely acknowledge that to convert our streams into open sewers is very unwise in every sense of the word. The public have apparently ranged themselves into two classes on this question, as they do on almost every public one, those, consisting principally of manufacturers, who oppose legislation having for its object the prevention of the pollution of rivers on the ground of its interference with trade, and another class who advocate their restoration to the condition of trout streams. To permit the filthy inky watercourses of the manufacturing districts to remain in their present state is to allow a few score of men to afflict thousands with gigantic public nuisances. To quietly sanction the pollution of 3,000,000 gallons of river water daily by five firms, as at Bradford, and to complacently allow 75,000 tons of cinders to be annually deposited in the river Irwell is of course suicidal policy. To argue that, because manufactories which pollute streams and air give sustenance to hundreds and thousands of work-people on their banks, whose vital energies are lowered (thus rendering them a more ready prey to disease) and whose offspring are stunted and depraved by the unwholesome influences to which they are subjected; to argue, I say, that, because these great industries fill the stomachs of these people, they ought not to be required to be conducted in a manner which is not detrimental to their health, shows a want of all proper feelings of humanity. Whilst, however, condemning an extreme degree of pollution, I do not, like many, think that it would be wise to be too exacting as to purity.

Those who are acquainted with the practical working of the Sanitary Acts and are engaged in an incessant warfare with the development and spread of preventible diseases know full well that the principles on which all their work rests consists mainly in the prevention of air pollution and of water pollution. Filth in the air we breathe, and filth in the water we drink is the one great enemy in two different media against which we Health Officers are always fighting. As the question of the pollution of rivers is primarily and essentially a sanitary one, and secondarily a commercial or pecuniary one, why, I ask, should not the same principles be applied in dealing with it as with all other sanitary evils which involve exactly similar considerations. It will, I presume, be acknowledged that for legislation on this question to be possible all extremes must be avoided. To advocate the restoration of our streams to a state of purity resembling that of a mountain rivulet is to obstruct and in fact to oppose all legislation on the matter. The crippling or destruction of many industries of national value would necessarily follow such an enactment, for the expenditure incurred in purifying their waste waters would consume or most

* Abstract of a paper read at the Social Science Congress of 1875, October 13.

seriously affect their legitimate profits. I maintain, moreover, that, if it were possible, it would be force wasted, for no adequate compensatory advantage would be gained. All who have paid attention to the very interesting topics as to the effects on health of various kinds of water agree that spring water is to be preferred to all other kinds, and that river water unpolluted to any extent by sewage needs more or less of purification by filtration, &c., which is costly, before it is fit to drink. The Duke of Somerset placed the matter in its true light when he recently said in Parliament:—"The foul matters encumbering streams may be got rid of, but the notion of their supplying water fit to drink must be altogether put aside. Towns must be supplied with pure water for drinking purposes in some other way." As the prevention of the pollution of the foulest of our streams would seem to necessitate the stoppage of important industries, and the purification of such streams so as to render them adapted for drinking purposes is of course not to be thought of, let us ask ourselves the questions (1) What harm do these streams corrupted by sewage and trade products do, and (2) How are they to be prevented from inflicting injuries?

(1) WHAT HARM DO THESE STREAMS CORRUPTED BY SEWAGE AND TRADE PRODUCTS DO?

(A) *Many of them pollute the air lying over them and on their banks.* Noxious odours sometimes or always arise and annoy those who live near them, or those living at a distance who approach them. If human beings are exposed frequently to unpleasant smells a deleterious influence is exerted on their health. I know all that may be said in opposition to this statement. I shall be referred to the absence of any noticeable evil effects in London during the year when the Thames was so odoriferous, and to the supposed immunity from cholera and other preventible diseases of the sewer men of Paris, &c. It is a well established rule, to which there are some apparent exception, that there is a greater mortality amongst those who are exposed continually to offensive odours than with others who are not so circumstanced, and that the diseases from which the former suffer are of an asthenic type and tend to death rather than to recovery. A certain amount *vis medicatrix naturæ* is lost by them and its want is felt at critical periods of sickness when most needed. Evaporation is constantly in a greater or less degree proceeding from the surface of water, and organic impurities contained in the water, if excessive, are mechanically conveyed into the air during this process of vaporisation. The odours of many of these rivers, like those of foul ponds, are generally noticed more at sunrise and sunset than at other periods of the twenty-four hours, in consequence of the descending dew preventing their diffusion and rendering the impurities soluble and thus more perceptible to the sense of smell. My experience as a physician has taught me that it is prejudicial to health to frequently breathe air polluted by emanations from very foul water. Unpleasant smells are danger signals, and although it is absurd to fear an attack of illness whenever we have our olfactory nerves offended, yet there can be no hesitation in saying that the continual exposure of the human frame to polluted air tends to engender ill-health even if it does not create disease. The contamination of the air by many of these streams is as great a nuisance (taking this word in both its literal and legal or popular sense) as the pollution of the air by volumes of smoke which is, subject to some saving provisions, an actionable offence.

(B) *Many of them destroy fish.* Certain kinds of fish, such as the trout, require, in order to live, water of great purity. Others, such as chub, dace, roach, jack, barbel, perch, pike, eels, &c., flourish in water which would be considered comparatively dirty, whilst no fish whatever will, I believe, live in some of the most impure streams, and in those poisoned by the metallic waste of mines. In rendering streams so foul or poisonous that no fish can exist in them certain manufacturers and miners

damage one of our food resources, by rendering an important article of diet scarce and dear, and therefore not to be procured by the poor man, and by lessening the self reliant powers of the country.

(c) *Silting up of watercourses and obstruction to navigation.* The quantities of solid impurities thrown into some streams are so great as to fill up their beds, thus creating inundations of their banks higher up. These solid matters produce a silting up of rivers, and an obstruction to navigation by the accumulation of offensive banks of mud. On public grounds these evils should be rendered impossible.

(2). HOW ARE THE STREAMS TO BE PREVENTED FROM INFLECTING INJURIES?

The injuries being the pollution of the air (for no one ever thinks of drinking such water) the destruction of all kinds of fish, or an obstruction to navigation, and to the escape of surplus waters during flood, my answer is simply and solely the following:—Let our scientific chemists ascertain the point at which a stream begins to be so impure as to contaminate the air lying over it, and here let a line be drawn. Let them ascertain the point at which a water becomes so impure as to prevent life and multiplication of the less particular of the finny tribe, and here let another line be drawn. Let them ascertain the amount of suspended impurities a stream may contain without depositing in its course sufficient to offer at some future time an obstruction to the ready escape of floodwaters and to navigation, and here draw a third line. Whether these lines would coincide or not, I do not know. Probably not. The nature, as well as the quantity of the impurity, would have to be considered in a question of this sort, the rapidity of the stream, and many other matters. Standards of some kind we must have, as well for the protection of the innocent as for the ready conviction of the guilty. To attempt legislation without any definite rules for guidance would be to court a failure. I maintain, then, that, instead of establishing such impracticable standards as were recommended by the Rivers Pollution Commission, we should adopt three simple standards of the kind just indicated. No stream should corrupt the air lying over it or on its banks, under any conditions of air pressure, temperature or humidity, or level of its waters, for, if it does, it is detrimental to the health of those living near it. No amount of impurity in a river should be tolerated which would injure one of the food supplies of the people, to wit, the less dainty feeders amongst our river fish. No stream should contain so much suspended impurities as would tend to its obstruction in time of flood and to the silting up of the mouths of navigable rivers. As for the practice in some parts of shunting large quantities of cinders, ashes, and solid refuse into streams in order to avoid the expense of carting them away, and of placing solid matters on the banks of rivers, so that they may be washed into them in times of flood, such proceedings should be rigorously prohibited by law as being injurious to public interests.

As regards the pollution of *tidal* rivers, the law, as it at present stands, is not in accordance with the spirit of the rest of sanitary legislation. It is illegal to pass any filth into a tidal river according to the Public Health Act of 1875. If filth is passed into a river, and any one can show that he is injured thereby, the Health Authority of the district is liable to an action at law. Some rivers are guarded by conservators or water bailiffs, whilst others are not so cared for. How are the silting up of the banks of tidal rivers, and the accumulation of filth interfering with navigation, to be prevented in the case of rivers not fortunate enough to be possessed of guardians? It is of no use to forbid a thing whilst unpossessed of any power to prevent that which is forbidden from being effected.

To establish three simple standards of the kind which I have suggested is to extend the sound principles of sanitary law, the burden of which is that you shall do nothing which is injurious to the health of your neighbour or to the public welfare.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS
DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 219.)

On the evidence of these documents the procedures for illumination with hydrogen hitherto employed must be condemned if anything further is desired than the display of objects and transparencies for the lecture-room or the stage.

Hydrogen lighting was not represented at the Vienna Exhibition—a further indirect evidence that it had not found any wider application.

An objection, long known, depends on the high coefficient of diffusion of hydrogen, and its consequent ready escape through the pores and fine chinks of the mains, a circumstance the more dangerous, as hydrogen is not, like coal-gas, at once detected by its odour. The diffusion-coefficients of gases, according to Graham's experiments, are inversely as the square roots of their specific gravities.

But if lightness is a disadvantage for the delivery of hydrogen through pipes, we have now to consider the advantages springing from the same attribute. In November, 1872, a dream long cherished seemed on the point of fulfilment. The Brothers Etienne and Joseph Montgolfier sent up the first balloon at Avignon by means of hot air.†

With natural enthusiasm the populace of Annonay applauded them when, on June 4, they repeated the experiment of the previous year on a larger scale, and king, court, and capital congratulated the inventors when they repeated it soon afterwards at Versailles. The dominion of the air seemed won for mankind, to whom space had now no limits. To day we look back upon the invention with a cooler glance, as, in spite of the lapse of ninety years, it has remained in its infancy. We are still unable to speak of aerial navigation, since the balloon, incapable of being steered, has remained the plaything of the air instead of becoming its ruler. One step, indeed, towards the desired end was taken when Charles, Professor of Physics at the Conservatoire des Arts et Métiers, at Paris, substituted hydrogen for the heated air in the balloon. On August 27, 1783, Charles, in concert with the Brothers Robert, skilful mechanics, accomplished the ascent of the first hydrogen balloon in the Champs-Élysées, his invention being known as the *Charlière* in contradistinction to the *Montgolfière*. Both systems were used for the first aerial voyage, the one in November and the other in December of the same year. Previously the balloons had been sent up empty, or only tenanted by some animal. The first aerial navigator, Pilâtre de Rozières, conceived the idea of combining both systems, which was the occasion of his death. The fire in the *Mongolfière* was communicated to the hydrogen in the *Charlière*, and on June 15, 1785, balloon and aeronaut fell shattered on the limestone rocks of the coast, near Boulogne.

The motive for this unfortunate combination was the wish to raise or lower the balloon by stirring up or extinguishing the fire—a plan which makes ballast superfluous, and which has been revived in a recent essay‡ by Captain Gaede (of the Military School at Hanover), and with due precautions would be doubtless practicable. Since the time of Pilâtre de Rozières 3700 balloon ascents have been undertaken, and only sixteen fatal accidents have been heard of,|| due chiefly to *montgolfières*, though the

sea has been repeatedly crossed by *aéronauts*. Not long after the discovery of balloons they were used both for practical and for scientific purposes. Coutelle used them for military reconnoitring, and according to Carnot's testimony, contributed essentially to the result of the battle of Fleurus. On the other hand, Captain Gaede considers the results attained by means of balloons, especially in reconnoitring fortified places, both in earlier campaigns and in the Franco-Prussian war of 1870-71, as insignificant. Napoleon I. regarded the military efficiency of the balloons of his time not more favourably. After his return from Egypt—where the attempt to convince the natives of the superiority of Europeans by means of a balloon ascent had failed, owing to their fatalistic indolence—he closed the military-aërostatic school which had been founded at Meudon under the management of Coutelle and Conti, evidently holding its military results as unimportant.

(To be continued)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. O. C. Mackenzie, Thomas Purdie, and W. S. Carpenter were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. W. S. Curphey, E. A. Sturman, M.A., J. Kershaw, G. W. Rawlins, A. Boak, R. L. Barnes, W. E. Halse, T. H. Dodd, E. Payne, R. Harvey, J. F. M. H. Stone, E. H. Girling, J. Monckman, T. McKean, A. Taylor, T. H. Bland, S. Wills, E. H. Cook, A. St. Clair Buxton, J. C. Oman, J. C. Thresh, A. W. Postans, P. R. Ogle, F. C. Desvignes, F. M. Jennings, and S. A. Prus Szczepanowski. For the third time—Messrs. Alfred William Gerrard, James Brett Guyer, Ernest Gee, and Alfred Newton Gow, who were balloted for and duly elected.

The first paper was by Mr. G. JOHNSTON, "*On the Decomposition of Stearic Acid by Distillation under Pressure.*" Although solid paraffin is not altered by being heated to its boiling-point in a sealed tube, Thorpe and Young have shown that, when repeatedly distilled under pressure, it is resolved into liquid hydrocarbons. Now Berthelot found that stearic acid was scarcely altered by being heated in a sealed tube to 300°, or by simple distillation; it seemed probable, however, that a different result might be obtained if it was distilled under pressure. On making the experiment, this was found to be the case; oily compounds are formed, together with water and carbon-dioxide. An examination of the product showed that it consisted chiefly of a mixture of paraffins and olefines, with a small amount of ketones. The author believes the stearic acid to become dissociated at a high temperature, and the products, being quickly cooled in the condenser, are removed from the sphere of action before they have time to re-unite.

Mr. DAVID HOWARD said a very interesting point presented itself with reference to this dissociation of stearic acid, and that was the reversal of the process so as to form again the acid from the products obtained. If this could be done, it would throw much light on the constitution of the body.

The PRESIDENT having thanked the author,

Dr. C. R. A. WRIGHT read a paper "*On Isomeric Terpenes and their Derivatives*" (Part V.), by himself and G. H. BECKETT. The paper contains an account of the peppermint camphors from Japan. The solid camphor consists of an alcohol, $C_{10}H_{19}.OH$, which splits up, by the action of dehydrating agents, into water and the hydro-

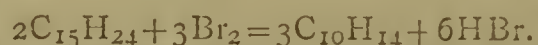
* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† The historical details concerning *aéronautics*, where no other authorities are given, are taken from the excellent summary of Louis Figuier in *Merveilles de la Science*, ii., 426-626. See also Marion, "Les Ballons," Paris, 1867; and Fonvielle, "La Science en Ballon," Paris, 1869.

‡ Gaede, "Ueber den Bau Gefesselter und Lenkbarer Luftschiffe." Berlin: Mittler, 1873.

|| Stephan, "Weltpost und Luftschiffahrt." Berlin: 1874.

carbon menthene, $C_{10}H_{18}$; this unites with 4 equivalents of bromine, forming a compound $C_{10}H_{18}Br_4$, which, when cohobated for a few hours until hydrobromic acid ceases to be evolved, and then distilled over sodium, yields nearly pure cymene. By oxidation with chromic mixture this gives acetic acid and terephthalic acid, and with nitric acid paratoluic acid. It is identical, therefore, with the cymene obtained from other essential oils. The liquid camphor appears to consist of a solution of the solid camphor in a liquid of the composition $C_{10}H_{18}O$. The authors also treated the hydrocarbon, $C_{15}H_{24}$, obtained from oil of cloves, with bromine, in the proportion indicated by the equation—



A heavy oil was obtained which, on being heated, evolved hydrobromic acid, but no cymene could be isolated from the product, a hydrocarbon of the composition $C_{15}H_{22}$ being produced. They also examined the liquid which drops from the mass of camphor during the process of sublimation. It seems to be a complex mixture probably containing a hydrocarbon of the terpene series, a body of the composition of the hydrate of a terpene, $C_{15}H_{18}O$, and a liquid oil containing less hydrogen than camphor, together with much ordinary camphor.

Dr. GLADSTONE said he felt much gratified with the results obtained by the authors. The whole series of these terpenes was of especial interest, and the authors had materially added to their knowledge of the differences, both physical and chemical, which existed between the C_{10} and the C_{15} groups.

Mr. KINGZETT remarked that Professor Church had obtained the $C_{15}H_{24}$ by continued digestion with sodium. Now, as all the C_{10} hydrocarbon group gave peroxide of hydrogen when exposed to moist air, and as the hydrocarbon $C_{15}H_{24}$ does not give it, whilst oil of cloves itself does, it was possible that the former might be produced by the polymerisation of a $C_{10}H_{16}$ compound.

Dr. WRIGHT said it was not impossible that the oxidised constituent of clove oil, eugenol, which is a benzene derivative, might give rise to the hydrogen peroxide.

Dr. ARMSTRONG observed that the evidence of the existence of a $C_{15}H_{24}$ hydrocarbon in the natural oils was placed beyond all doubt by the researches of Dr. Gladstone. These compounds were higher homologues of benzene, probably tripropylated benzenes.

Dr. WRIGHT then read a second paper, by himself and Mr. BECKETT, "*On the Alkaloids contained in the Aconites*" (Part I.). The material for this investigation was furnished by Mr. T. B. Groves, who prepared it in the manner described in the "*Year-Book of Pharmacy*," 1873 and 1874. The authors describe several bases which they have isolated from this mixture, one of which, having the composition $C_{31}H_{45}NO_{10}$, appears to be comparatively inert, whilst another, of the composition $C_{33}H_{45}NO_4$, has a powerful physiological action. A pseudaconitine, $C_{36}H_{49}NO_{11}$, which forms indistinctly crystalline masses, was also obtained. The authors consider that either the roots of the aconites contain several alkaloids capable of crystallising or of giving crystalline salts, or else that the alkaloid originally present is readily alterable and gives rise to numerous altered products during the processes of extraction and purification.

The PRESIDENT, in thanking the authors, said he was happy to see that they had taken up another subject which seemed likely to be fruitful in interesting results.

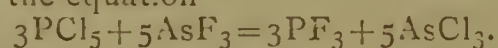
Mr. F. J. M. PAGE then gave an account of "*A simple form of Gas Regulator for maintaining a Constant Temperature in Air-Baths, Water Baths, Incubators, &c.*" This apparatus, which is difficult to describe without a woodcut, consists essentially of a large mercurial thermometer, the bulb of which is placed in the water-bath or other apparatus to be regulated; one end of a movable tube, through which the gas passes, just touching the surface of the mercury in the stem. A bye-pass is provided in the gas system which allows some gas to pass to the burner, but not sufficient to keep the apparatus at the

right temperature, the extra supply required for that purpose passing through the regulator. It is somewhat similar in principle to Bunsen's regulator, but as the thermometer is mercurial, and not an air one, it is unaffected by barometrie changes; moreover, the whole apparatus being of glass, is not likely to get out of order.

The PRESIDENT said the thanks of the Society were due to Mr. Page for the description of his gas regulator, which left but little to be desired in point of simplicity. During the past few years he had had considerable experience in the matter, and had found Scheibler's electric gas regulator act exceedingly well; but it was not so simple, and far more costly than the present one.

A paper "*On the Fluorides of Arsenic, Phosphorus, and Iodine*," by R. W. E. McIVOR, was then read by the Secretary. In this preliminary notice, the author states that arsenic trifluoride, AsF_3 , may be readily obtained by distilling a mixture of arsenic trichloride, calcium fluoride, and sulphuric acid; also from arsenic tribromide and ammonium fluoride. It is a strongly-fuming, colourless liquid, which, when dry, does not act on glass. When arsenic fluoride is added to phosphorus tribromide or chloride, heat is evolved and phosphorus trifluoride formed. It boils at about 60° . Iodine pentafluoride is formed by the action of iodine on argentic fluoride; it is a volatile, colourless liquid, which does not solidify at -20° ; it fumes in the air, and is decomposed with violence by water. Ethyl and methyl fluorides are gases at the ordinary temperature.

Dr. ARMSTRONG, after stating that Professor Thorpe had been working on this subject for some time, and had already given some account of his results at the meeting of the British Association at Bristol, gave extracts from a letter he had received. Mr. Thorpe had found, on adding arsenic trifluoride to phosphorus trichloride, that the liquids do not even mix; but, on gently heating, gas is evolved, and the residue consists of arsenic trichloride. If phosphorus pentachloride be substituted for the trichloride, the action is very energetic and proceeds quite regularly, according to the equation—



The phosphorus pentafluoride is a gas which fumes strongly in contact with moist air, and is instantly decomposed by water, with production of phosphoric acid and hydrofluoric acid. The vapour density determination of the gas agrees well with the theoretical number 63.

Another paper by Mr. McIVOR, "*On the Iodides of Antimony*," was then read. He prepares the iodide by adding the requisite quantity of antimony to iodine contained in a suitable vessel, applying a gentle heat at first. It melts at 164.4 , and boils and sublimates at a higher temperature. The author could not obtain a penta-iodide of antimony by the action of iodine on antimony.

The last paper was "*On Toly-Phenyl, a new hydrocarbon*," by T. CARNELLY. This hydrocarbon, which is the (1.4) modification of phenyl-methyl-benzene, $C_6H_5.C_6H_4.CH_3$, was prepared in the usual way by the action of sodium on a mixture of bromo-benzene and pure (1.4) bromo-toluene diluted with ether. The product was then submitted to a series of fractional distillations: the yield, however, was but small—only 9 per cent. Toly-phenyl is a colourless liquid boiling at 263° to 267° , which, when oxidised with nitric acid, yields diphenyl-carbonic acid, $C_6H_5.C_6H_4.COOH$. It melts at 217° , and in all other points resembles the acid obtained by Schultz and by Doebner. The author has also obtained various substitution compounds from the hydrocarbon, including two isomeric mono-nitro-derivatives and the corresponding amido-compounds, also a dinitro-toly-phenyl.

After returning thanks to the author for his interesting communication, the PRESIDENT adjourned the meeting until Thursday, November 18th, when the following papers will be read:—(1) "*Ethyl-Phenyl-Acetylene*," by T. M. Morgan; (2) "*On the Presence of Liquid Carbon-Dioxide in Quartz Cavities*," by W. N. Hartley; (3) Addendum to the Paper entitled "*Monthly Analytical Examination of*

the Harrogate Spas, 1872," by R. H. Davis; (4) "On certain Bismuth Compounds," by M. M. P. Muir; (5) "On the Formation of Cinnamic and other analogous Acids," by W. H. Perkin; (6 and 7) "On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol" and a "Note on the Action of Nitric Acid on Tribromo-Phenol," both by H. E. Armstrong; (8) "On Narcotine, Cotarnine, and Hydrocotarnine," by G. A. Beckett and C. R. A. Wright; and (9) "The Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by J. H. Gladstone and A. Tribe.

SCHOOL OF PHARMACY STUDENTS' ASSOCIATION.

THE above Association held its first meeting for the session of 1875-76 at 17, Bloomsbury-Square, on Thursday evening, October 21, Professor ATTFIELD, President, in the chair. There were present between thirty and forty members and some visitors.

The Secretary reported that during the last session the number of members had been fifty-eight, and there had been fourteen meetings. The first was held on January 21, when Professor Attfield, who had consented to become the permanent president, gave an introductory address, in the course of which he explained the educational aims of the Association, and sketched out the mode of accomplishing its object by members reading and discussing essays or papers on subjects connected with pharmacy and the sciences on which pharmacy was based. At the subsequent meetings the following papers were read:—"On Catalysis," by Mr. Chas. Shapley; "Antimony and its Compounds," by Mr. Arthur Hunt; "Pharmaceutical Ethics," by Mr. J. M. Broad; "The Analysis of Urine and its Physiological and Pathological Significance," by Dr. Senier; "Fermentation," by Mr. Chas. R. Riley; "French Pharmacy," by M. E. De Franciosi; "The Life of Count Rumford," by Mr. Harold Senier; "An International Pharmacopœia," by Mr. J. M. Broad; "Diet as a Therapeutic Agent," by Mr. Chas. J. Boorne; "The Correlation of the Physical Forces," by Mr. W. H. A. Naylor. These papers, the Secretary reported, were being transcribed into a book for circulation among the members.

The President then spoke of the pleasure felt by members of the council of the Pharmaceutical Society, and by the Professors of the School, in the continued prosperity of the Association, welcomed the old and new members of the Association and the visitors, and addressed those present "On the Best Means of acquiring Education as distinguished from Knowledge." By knowledge, he said, he meant that which they directly learned at school, in the shop, and as students, that in which they could be examined. By education, he meant, as he had elsewhere stated, enlightenment of the understanding, mental training and discipline, and general elevation of the intellect. By knowledge they could obtain a licence to practise their calling; education would enable them to practise it with success, and with real pleasure to themselves. By knowledge they would get through life; by education they would pass life happily and nobly. Let them not think that a certificate given by their examiners was a guarantee of education—it was only a guarantee of their possession, at the time, of more or less information in certain branches of knowledge. Examination called forth knowledge necessarily, not necessarily education. For the good of pharmacy and all pharmacists, he hoped the day would soon come when the Pharmaceutical Board of Examiners would be able to set their seal, not only to knowledge, but to a compulsory curriculum of study specially designed to promote education. Meanwhile students must for themselves seize all opportunities for education. The best method of acquiring education was to cultivate their powers of observation, perception, and description. From statesman to shopman,

the successful men were first those whose eyes and ears were trained to receive correct impressions, or, in other words, those who were trained to observe accurately. Next, they were those who could best see through men and their motives, as well as nature and her forces; in other words, those trained to perceive intelligently. Thirdly, they were those who could best describe what they had observed and perceived. Let any member of the Association observe carefully the work of a Faraday or a Linnæus, let him endeavour to perceive the aims of such men or the working of the laws they unveiled, and then come to the fortnightly meetings prepared to describe what observation and perception had taught him, and he would help to educate his fellow-members and most certainly would educate himself. And other subjects, such as those discussed during the past year, would equally well serve the purpose. Beyond all personal advantage, also, pharmacists were bound to promote their well-being as a brotherhood and the well-being of the calling in which they were engaged. Councillors, teachers, examiners, and other representative men would be required, to fill positions which could be only worthily occupied by the well-informed and well-educated. Every member of the Association should do his best to promote its stated objects; the result would be that each would become a better man and a better member of Society.

A Committee was then appointed to examine the voting-papers, and this being done, the following were announced officers:—Vice-Presidents: Mr. Arthur Hunt and Mr. W. A. H. Naylor; Committee: Mr. Harold Senier, Mr. John L. West, Mr. Thomas Slater, jun., and Mr. Henry G. Greenish; Secretary and Treasurer, Dr. Senier, F.C.S., 17, Bloomsbury Square, W.C. A vote of thanks having been given to the President, the Association adjourned.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 6th, 1875.

EDWARD SCHUNCK, PH.D., F.R.S., &c., President, in the Chair.

MR. J. S. KIPPING and Mr. W. A. Cunningham were appointed Auditors of the Treasurer's accounts.

"*A Study of Peat*;" Part I. By R. ANGUS SMITH, Ph.D., F.R.S., &c., V.P.

The author referred to a former paper, in which he stated his belief that calculations as to the age of peat bogs were frequently much exaggerated, and that the more highly combustible bodies called hydrogen and richer hydrogen compounds increased in proportion to age, not by addition to their substance, but by the oxidation of the other parts, and removal of carbonaceous bodies in the brown water.

After referring to the observation of oil from peat and treatment of the subject and its relation to questions connected with coal, by E. W. Binney, F.R.S., he now wished to bring forward certain scientific and certain economic points. Of the former: 1st. The rapid growth of peat, shown partly by collected experience and by numerous quotations. 2nd. The existence of the resins and bodies having a high amount of hydrogen and carbon in new as well as old peats. 3rd. The cause of the rather greater amount in the old, not from formation during decay of the plant, but their greater permanence and insolubility. 4th. The existence of similar bodies in the fresh mosses which form the peat. 5th. The possible removal of all woody fibre by decomposition, leaving only oils and resinous or similar bodies undergoing little if any chemical change. 6th. The reason, viz., that woody fibre produced no highly combustible liquids or solids during its decomposition. 7th. Suggesting that the same idea might be transferred to coal without confining it to any portion of the plant. 8th. The rapid formation of

hard peat promoted by the growth of fine mosses, which break down readily into fine powder, whereas strong stems remain long.

Next, certain economic and sanitary points. 1st. The importance of keeping up in certain parts of the country a sufficient amount of peat for the fuel of the neighbourhood. 2nd. The possibility, by proper peat culture, of increasing the growth manifold. 3rd. The question of the removal of the resinous, &c., bodies by solution instead of distillation. 4th. The value of peat as a reservoir of water. 5th. Its value as a rapid grower, if properly cultivated, for filling up wet ground and swamps. 6th. Its subsequent use in removing swamp fever, which was never found, at least in the northern peat bogs, and he believed never in the true peat bog, the cold not being the cause of this.

On recent enquiry, he had found peat which, on good evidence, had grown 30 inches in 44 years, and observers with still better opportunities gave amounts much higher, equal to 88 inches in a similar time. Taking the lower estimate, it seemed clear that Sprengel's statement was correct, that peat grew more combustible matter in an acre than forest trees grew. The specimen in question, from Deeside, on a spur of the Grampians, had a considerable density, viz., 0.92, measuring externally, or a cubic foot weighed 57 lbs., whereas a cubic foot of water weighs 62.32. The probably very cold peat of a coaly fracture spoken of by several persons is not here alluded to, and did not come under the author's observation. The amount of the wet material that grew in an acre was 2454 cubic feet in a year, and of the dry material, taking the lowest estimate of 1.6th, 10.2 tons, say 10. The estimated amount for wood in the plains below was considered to be 2½ tons per acre per annum, and this may be high, as Liebig gives only half this amount, and hay and straw, which he considered able to produce the same amount of dry material, do not produce more. The value of the peat and the wood as combustibles would differ little. The value of the 10 tons may be considered as equal to 4 tons of coal. These 4 tons, then, were grown on land which could scarcely be said to have agricultural value. Of course all bogs are not always growing at this rate, and there is a limit in time to their increase; on the other hand, by care and proper feeding, we may be able to grow the material much faster than ever it has grown, and the black bogs may become for us rich coal fields, oil wells, and whale fisheries. The fuel is not important for those places where coal is cheap, but there are many places in Great Britain where coal is difficult of transport. Since peat will not bear much carriage, its value is limited in distance, and in many places now without any it would be well to grow along with oat and potato fields a field also of this despised fuel. This is actually done, but it is rarely systematic, and in many places peat is driven out where a portion of land otherwise almost useless might be set aside for it. The systematic fostering of peat so as to increase the produce is advocated for many places, although this may appear absurd in the eyes of those who are desirous of removing entirely all its traces.

The peat which had grown rapidly was fine in texture and became heavy on drying; not of the heaviest kind, as 0.92 is high but not of the highest class. (The lightest peat examined was 0.2). The first had grown from fine or small mosses, *hypnum* chiefly, and the fineness of the fibre was apparently the cause of the rapid breaking up. It is not time alone then that is always required to make fine dense peat. Large pieces of wood may endure and be preserved long. Henceforth a new classification of peats is necessary, and this is according to the prevailing plant. To grow good peat all plants with thick stems must be avoided as giving too much woody fibre, rendering the structure too open and the peat too light, as well as giving an inferior amount (in the case of some woods at least) of the resinous and very inflammable bodies, and generally taking too long to form. The great peculiarity of good peat is the oleaginous and resinous matter, to which also wax and fats may be added, as they have been

found by some. It has been generally believed that these bodies have been produced during the decomposition of the plant, although one writer, quoted in the paper, considers they were produced by the growing plant. Dr. Smith came to the conclusion that woody fibre could not be shown to produce substances rich in hydrogen, the compounds resulting from its decay were rather of a humous character and not good combustibles. If woody fibre did not leave its hydrogen and carbon in such quantity as to form the resins, &c., of peat, then we must look for the origin in the growing plant. The mosses from which the peat from Deeside was evidently grown were examined, and on drying gave about a fourth of dry matter which readily crumbled into a powder and which contained 1.27 per cent of substances soluble in a light naphtha. It much resembled that obtained from the peat, but was softer, being about the consistence of butter and capable of being distilled so as to give a yellowish substance of the same consistence. Besides this there was 1 per cent of a substance extracted by alcohol, resinous in appearance, fusible, and containing apparently the chlorophyll.

The author believed that these bodies produced the similar matter in the peat, or rather were the matter itself with little or no change. In the peat it had been hardened, perhaps by oxidation or perhaps by the removal of the more fluid portion by water. In this way he explained the possibility of having a flow of oil from a peat moss. When the substances in the plants themselves were of a more fluid character, the removal of the woody fibre and absorbing humous bodies would set them free, and the fusibility or otherwise of the substances at ordinary temperatures would depend on the plants. The oil formed by distilling the resinous bodies obtained from the peat was of a light yellow. Its true character has not been fully determined, but the analysis gave—Carbon, 83.86 per cent; hydrogen, 12.70.

The author inclined to believe that there is a great variety of oils and solid hydrocarbonaceous bodies, if not true hydrocarbons, in the plants, which so far as he knew had not been examined. The resins of the peat had been carefully examined by Mulder.

The author had not found any of the coaly peat spoken of by some authors. It might readily be supposed that when the woody fibre was removed various compounds insoluble in water would remain and account for fossil resins, ozokerit, &c. A similar action might produce coal, although the plants forming peat and coal were different and most probably the climate, and the idea of Prof. Morris (see Prof. Huxley and Prof. Dawkins on coal) that the bituminous part of coal was composed of spores and sporangia primitively supplied with resinous or oleaginous matter would so far agree with the above reasoning, although in forming peat we cannot confine ourselves to the spores, so far as the author knew at least, when wood is present having resin dispersed in it. Perhaps the same may be said of coal.

The author spoke of the great value of peat as a water reservoir in a country demanding so much water, which did not always require to be bright, and of the possibility in many positions of clearing it as it was leaving the mosses. Water reservoirs could thus be grown at a cheap rate in many spots, instead of being banked in or dug at a great expense, although growing might require perhaps more time. A reservoir formed of peat 10 feet thick would hold as much as a water reservoir of the usual kind 8 feet deep, or say 7½, and still be easily walked over.

The capacity of growing possessed by peat was so great, if the results found can be readily attained in many places, that in suitable situations it might be used for filling up swamps and making dry surfaces, for after rising to a certain height the top easily drained and left a part dry.

Swamps were sources of fever and ague. True peat bogs never were, so far as the author knew, and probably the growing of peat would render many places healthy

which could not otherwise easily be made so. Gases from peat mosses it is intended to examine more fully, and also many peat-forming plants.

SOCIETY OF PUBLIC ANALYSTS.

ON TEA.*

By G. W. WIGNER.

(Concluded from page 190.)

THE total weight of the ash of tea extract and the ash of exhausted leaves is almost invariably in excess—and sometimes very greatly so—of the ash of the tea itself, the increased weight being in some cases as much as 1.5 per cent. It is not easy to find any definite reason for this increase, which, however, appears to be mainly due to the fact that the ash of exhausted leaves and of tea extract contain together a larger proportion of carbonic acid than does the ash of tea.

Pulverised tea appears, however, to show a larger increase than whole leaf, and those samples which have been repeatedly boiled a larger increase than those which have been only boiled once in a 1 per cent solution.

The percentage of tannin in tea is very variable, and there is little doubt that this is, in a great degree, the cause of the erroneous estimate which English tea drinkers frequently make of the dietetic value of tea. They prefer tea which gives a dark coloured infusion, and has some sensible astringency, to those varieties which give a paler and a less bitter liquor. This probably accounts, to some extent, for the high estimation in which some kinds of Assam are held for mixing purposes. The acetate of lead process seems more reliable for determining the percentage of tannin than the old gelatine process, and it is certainly easier. I have therefore adopted it. I find that a sample taken from a mixture of six samples of Assam tea gave 45.5 per cent of tannin, while some of the highest results were—

| | Per Cent. |
|--|-----------|
| No. 82. Moyune young Hyson | 39.0 |
| No. 83. Very choice Assam | 33.0 |
| No. 1. Indian young Hyson | 39.0 |
| No. 97. Assam tea from Dr. McNamara's garden | 27.7 |
| No. 75. Caper (mixed) | 42.3 |

It is clear, therefore, that some teas exceed the average so greatly that, as regards adulteration or impurity, the tannin determinations can give only negative results. Sometimes, however, useful confirmatory evidence may be obtained from them: for instance, a sample of tea, originally of good quality, which had been sunk in a vessel for sixteen days, gave only 3.74 per cent of tannin, a figure closely approaching that which is yielded by ordinary exhausted tea-leaves (3.80 per cent).

The high percentage of nitrogen present in tea-leaves has been pointed out by Peligot and Wanklyn. This is, of course, partly due to the proportion of theine present (theine itself containing 28.87 per cent of nitrogen). The real commercial value of tea appears to depend to a considerable extent on its proportion of theine; and if the quantity were capable of more speedy and accurate determination it would be of much value. By the present processes it is, however, difficult, or even impossible, to get a trustworthy result. Zöller's figures, for instance, are about ten times as high as Mulder's.

I have made some few determinations of the total nitrogen in tea, with the following results:—

| | Per Cent. |
|---|-----------|
| Sample taken from 60 green teas, slightly faced | 3.76 |
| " " 60 black teas | 3.26 |
| " " 6 Assam teas | 3.64 |
| " " 6 Caper teas | 3.32 |
| " " Assam tea from Dr. McNamara's garden .. } | 3.88 |
| " " Sample of exhausted leaves | 3.80 |

* Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

I now proceed to consider the question of adulterated tea, premising that—as the result of the examination of hundreds of samples obtained in various ways, some from original chests, and some from retailers—I do not believe that any adulteration of tea is practised in this country. Years ago no doubt tea was occasionally faced here, and from samples which I have seen I should think very badly faced, *i.e.*, a large quantity of colouring matter was put on in such a clumsy way as to completely spoil the appearance of the leaf.

It is not uncommon for tea to be de-faced in this country, *i.e.*, to have the colouring matter either removed or so altered in appearance as to be rendered almost invisible.

As regards exhausted leaves, foreign leaves, and siliceous matter, I do not think that any Englishman could introduce them into tea so as to deceive the eye of a tea buyer, except at a cost which would render the operation unremunerative.

The Chinese have, however, special facilities for such operations during the process of "tea making," and years ago the introduction of exhausted leaves and sandy matter into low-grade Canton Capers and Ping Suey Gunpowders was by no means uncommon.

As far as I can judge, the high class teas have always been kept scrupulously free from such admixture, and this renders it even more certain that the presence of 4, 8, 9, and even 37 per cent of sandy matter (and I have found all these percentages in low class teas) must have been due to design, not accident.

Such tea seems, however, to have almost entirely disappeared from the English market during the last few years, and the inferior teas which are to be met with now are either the remainder of some old stock, or some chests which have been recovered from wrecked vessels and re-dried.

In the latter case the fact is generally evident from the tea containing a heavy percentage of common salt. Such teas are seldom offered here except for export, but the five following are illustrations:—

| | Total Ash. | Ash Soluble in Aqua. | Ash Soluble in Acid. | Silica. | Alkali Calculated as Potash. | Extract. | Chlorine Calculated as NaCl. |
|-------------------|------------|----------------------|----------------------|---------|------------------------------|----------|------------------------------|
| No. 84. Congou .. | 8.00 | 4.09 | 3.02 | 0.89 | 0.24 | 20.40 | 3.08 |
| No. 85. Gunpowder | 13.16 | 4.32 | 7.20 | 1.64 | 1.62 | 23.29 | 1.11 |
| No. 86. Congou .. | 5.35 | 2.44 | 2.17 | 0.74 | 0.61 | 26.48 | 1.14 |
| No. 87. Pekoe .. | 8.64 | 2.28 | 3.66 | 2.70 | 0.75 | 41.20 | 0.23 |
| No. 88. Caper .. | 8.23 | 2.42 | 3.53 | 2.28 | 0.80 | 36.45 | 0.17 |

The first of these had been more than a fortnight under water, and was completely soaked, and then re-dried. The two latter ones had merely been slightly moistened.

Sometimes samples have evidently been wetted, and some of the value extracted, even when salt is present in minute traces only. Thus I have found—

| | | | | | | | |
|-------------------|------|------|------|------|------|---|--------|
| No. 89. Hyson .. | 8.53 | 1.13 | 4.76 | 2.64 | 0.70 | — | traces |
| No. 90. Congou .. | 7.27 | 1.35 | 3.54 | 2.38 | 0.70 | — | traces |

While, again, the following are samples of tea which are obviously impure, though in the same state as when imported:—

| | Total Ash. | Ash Soluble in Aqua. | Ash Soluble in Acid. | Silica. | Alkali Calculated as Potash. | Extract. |
|---------------------|------------|----------------------|----------------------|---------|------------------------------|----------|
| No. 91. Gunpowder.. | 19.73 | 1.00 | 6.15 | 12.58 | 0.14 | 37.78 |
| No. 92. Caper | 14.44 | 1.95 | 2.47 | 10.02 | 1.03 | 35.45 |
| No. 93. " | 15.20 | 1.69 | 5.35 | 8.16 | 0.61 | 31.60 |
| No. 94. " | 15.08 | 1.96 | 5.65 | 7.47 | 0.73 | 35.60 |
| No. 95. " | 12.74 | 2.68 | 3.44 | 6.62 | 1.04 | — |
| No. 96. " | 14.60 | 2.67 | 5.87 | 6.06 | 1.04 | — |

It is clear from these figures that each of these samples is adulterated with from 6 to 12 per cent of sandy and other foreign matter. I do not, however, think they would be likely to be met with in this country now, although very

probably some of the foreign markets could furnish corresponding samples.

If the Custom's examination of tea, which we are now promised, is properly conducted, such teas as the above would of course be condemned, and the injustice of taking the duty on an article which it is illegal to sell would be obviated. It is to be hoped, in the interests of the tea trade, that the Customs' authorities will take care that the Analysts they appoint are not only sufficiently numerous, but that their individual experience will ensure the examination of tea being satisfactorily performed.

When I commenced this paper I purposed giving the complete analysis of a number of the ashes of tea, but the work has grown upon my hands, and it may be thought that the paper is already too long. I, however, append a few partial analyses, and I may probably some day, as opportunity serves, complete them, when I shall have pleasure in laying the results before this Society.

In the ash of a mixed sample of twenty-four genuine black teas, and in another of a number of medium quality (faced) green teas, I found—

| | Ash of Black Teas. Per cent. | Ash of Green Teas. Per cent. |
|---|------------------------------------|------------------------------------|
| Potash | 30.92 | 28.42 |
| Soda | 1.68 | 2.08 |
| Sulphuric acid.. .. . | 4.88 | 5.66 |
| Carbonic acid | 11.60 | 6.43 |
| Silica | 1.70 | 7.50 |
| Percentage of total ash soluble) in aqua.. .. . } | 57.00 | 52.85 |

In another case a sample of genuine black tea was ignited to ash, and another part of the same sample exhausted by boiling, the leaves and extract being also brought to ash, and the carbonic acid and percentage of soluble ash in each determined. The results were—

| | Carbonic Acid. Per cent. | Soluble in Aqua. Per cent. |
|----------------------------|-----------------------------|-------------------------------|
| Original tea ash.. .. . | 12.52 | 57.55 |
| Ash of exhausted leaves .. | 5.71 | 21.20 |
| Ash of extract | 16.72 | 84.15 |

I desire in conclusion to acknowledge the valuable assistance which I have received, in the experiments necessary to the compilation of this paper, from Mr. R. H. Harland, one of my assistants, and an Associate of this Society.

NOTICES OF BOOKS.

Sulphurets: What they are, how Concentrated, how Assayed, and how Worked. By W. BARSTOW, M.D. San Francisco: A. Roman and Co. London: Trübner and Co.

THE title of this book is somewhat misleading. The author treats merely of such sulphurets as are used in metallurgical operations as workable ores of copper, lead, zinc, mercury, or silver, and as contain gold in a state of mechanical dissemination. With the sulphurets used as sulphur ores, and of the way of determining the amount of sulphur they contain, he does not occupy himself. Perhaps "Metallurgy of the Sulphurets" would have been a more fitting title.

After a brief account of the sulphides of the ordinary metals, Dr. Barstow gives an account of the assay of gold, silver, lead, zinc, copper, and mercury in the dry way, adding instructions for the manufacture of "a very simple balance, which the reader can easily construct for himself, and which will be accurate enough for his purpose down to the one-thousandth of a grain." "Three weights," we learn, "are all that are necessary: one of one grain, one of one-tenth of a grain, and one of one-hundredth of a grain. The standard for the first may be found at any

drug store." The second weight is to be made of fine wire, and the third of very fine wire, broom-corn, or thread. We should except that an organic substance like thread, which sometimes absorbs and sometimes gives off moisture, according to the state of the atmosphere, and to which dust and dirt readily adhere, would not make a very constant and trustworthy weight.

A short chapter is devoted to wet assays, which he does not recommend, though he admits that they give more accurate results, especially in the case of rich alloys. He might have added that the Cornish assay of a copper ore, tolerably accurate for a rich ore, falls more and more widely short of the truth as the mineral is poorer, till a point is reached when the amount of copper is returned as *nil* by the dry process, though it still exists in quantities readily determinable by the wet method. Dr. Steinbeck's process for the assay of copper ores might, we think, have been usefully given.

In the next part Dr. Barstow treats of the various mechanical methods tried for concentrating the ore by separating, as far as possible, the gangue from the actually metalliferous portions of the ore. He gives the preference to the Prater concentrator, a Californian invention as improved by Hendy.

The fourth part describes the reduction of sulphuretted ores, and in the fifth follow some very brief instructions on the blowpipe assay of ores. An index would decidedly increase the utility of the book.

Chemistry: General, Medical, and Pharmaceutical. By J. ATTFIELD, Ph.D., F.C.S. Sixth Edition. London: J. Van Voorst.

WHEN a work has gone through six editions in eight years, and has met with general favour in England, in India, in the United States, and even on the Continent of Europe, the task of the critic is exceedingly limited. Whatever alterations have been rendered necessary by the advance of discovery since the appearance of the last edition have been carefully and judiciously made. The work has been extended by a notice of forty substances which are official in the Pharmacopœia of India, though not in that of Britain, and presents therefore the whole of the chemisiry of both Pharmacopœias.

For all the numerous class of students who are preparing for the medical or for the pharmaceutical profession, we know of no work in the language which can be compared with the one before us. To give so much, and so well-selected, and so admirably arranged matter in such brief compass is an achievement on which the author deserves our heartiest congratulation. His declaration that while "the truths of chemistry are the same for all students, the principles of the science can be as easily illustrated by or deduced from facts which have interest as from those which have little or no special interest to the class addressed" is suggestive. Among all our manuals of chemistry—so numerous and possessing so few distinctive features as almost to constitute a nuisance—have we one that offers the young technological chemist such advantages as Dt. Attfield's work provides for the tyro in pharmacy or in medicine? If not, why not? The example here set should certainly be followed.

Manuel Pratique d'Essais et de Recherches Chimiques Appliqués aux Arts et à l'Industrie. Par P. A. BOLLEY et E. KOPP. Traduite de l'Allemand sur la Quatrieme Edition, par Dr. L. GAUTIER. Fasc. 1 et 2. Paris: Savy.

WE have here the first two parts of an elaborate work on chemical analysis, qualitative and quantitative, as applied to the arts and manufactures. The book begins with instructions in manipulation, abundantly illustrated with woodcuts of apparatus. Then follows a chapter on reagents, their preparation, and their use, particular attention being given to volumetric solutions.

The section on the assay of waters, for domestic and industrial purposes, can scarcely be pronounced satisfactory. For the determination of organic matter the authors rely upon the perinanganate process, the untrustworthiness of which has been abundantly proved. The analysis of gases dissolved in water they perform by means of Winkler's apparatus, which is described and figured. Waters for domestic purposes, they consider, should not contain more than 20 parts of lime and magnesia in 100,000.

In the succeeding chapter the authors give directions for the quantitative and qualitative examination of simple non-metallic bodies used in the arts, pointing out their probable impurities and adulterations. It is interesting to notice, with reference to a late trial at Leeds, that our authors treat milk of sulphur and precipitated sulphur as identical, and, without any respect to English "trade-usages," class "salts of lime" among the possible impurities to be met with in the article, and not as a legitimate constituent.

In the section treating of the alkalies we have not been able to find any instructions for the assay of salt-cake and of tank-waste. The account given of the preparations of iron used in the tinctorial arts, with the impurities likely to occur, is excellent. Still we must remember that no quantitative determination of its ingredients can throw any very valuable light upon the working properties of a "nitrate"—more correctly named nitro-sulphate—of iron. Two samples may contain the same articles in the same proportions, and yet the one may, in practice, produce meagre chalky stains, whilst the other gives full solid colours. The same remark applies with no less force to some, at least, of the compounds of tin used in dyeing.

The process recommended for the assay of iron pyrites and of burnt sulphur-ores is that of Pelouze. We do not see the advantage of this method over the direct determination of the sulphuric acid formed by the oxidation of the sulphur.

For the determination of copper in ores and alloys the authors recommend the volumetric procedures of Pelouze and of Weil,—Park's method, and what we may call the Mansfeld processes, not being mentioned.

In treating of gun-cotton the authors remark that it is "sophisticated only with ordinary cotton." For the detection of this impurity they recommend to moisten the sample with a solution of iodine in iodide of potassium, and then with dilute sulphuric acid, examining the appearances presented with a lens. Common cotton is coloured blue, whilst gun-cotton takes a yellow tinge. Or small quantities of cotton may also be detected by taking advantage of the property of cotton to appear very clear and coloured if viewed by polarised light, whilst gun-cotton only reflects the light with a feeble intensity." We cannot agree with this passage. Raw cotton may occur in gun-cotton not intentionally, but from imperfect manipulation. Or it may be added, not with a fraudulent intention, but in order to reduce its "bursting power," and make it fit for use in fire-arms. It is, we think, best detected by digesting the sample with a large excess of acetic ether, in which all forms of nitro-cellulose dissolve, whilst raw cotton remains untouched. But in the examination of gun-cotton for military or engineering purposes it is of the first importance to ascertain how much of the sample is soluble in a mixture of anhydrous alcohol and ether. The soluble portion mono- and di-nitro-cellulose, has a much lower explosive power than the insoluble (tri-nitro-cellulose).

The work abounds in matter of the highest importance to the technological chemist and the commercial analyst, and its value will be further enhanced if, when complete, it is provided with a good index. A treatise of this nature—extending to 1000 closely-printed pages and well supplied with illustrations, and yet offered to the public at the price of 12 francs—is a phenomenon not yet acclimated in England.

CORRESPONDENCE.

ESTIMATION OF POTASH IN PRESENCE OF SODA BY THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—It seems advisable to append to the paper of mine you were good enough to publish (CHEM. NEWS, vol. xxxii., p. 217), on the "Pyrological Estimation of Phosphoric Acid," a few remarks on the other subject of the British Association's Report, estimated by means of the same neglected instrument.

The most difficult association with other oxides to determine potash pyrologically in, is undoubtedly that with different alkalies, especially soda. The presence of sulphates or chlorides, and of calcium or magnesium salts soluble in water, presents no difficulties whatever to the pyranalyst, the non-metallic constituents in the first adulterations being—thus created—extremely volatile, and the bases in the last insoluble in boric acid.

(1.) A 50-m.grm. bead of *pure boric acid* is fused before the blowpipe upon a platinum wire ring of small diameter, through which a slight blast from a blowpipe, having the platinum jet taken off, blows the red-hot bead into a bubble or vesicle about seventy times its first size. (This is the process I call "vesiculation.")

(2.) This vesicle freshly made is breathed upon strongly, and the resulting pale blue film or cloud carefully noted.

(3.) The vesicle (2) is thoroughly fused up again with about 5 m.grms. of *pure sodic carbonate*, the bead again vesiculated and breathed on, and the result noted. The pale blue film can be no longer produced, but instead of it is a colourless semitransparent tarnish, like that produced on a pane of glass by the breath. The addition of more soda will take even this away, until, as in the case of a *borax* vesicle, that remains quite transparent; but there is no necessity for this, as the distinction between the film and tarnish is quite sufficient for the purpose.

(4.) Fresh boric acid up to 20 m.grms. can now be fused on this bead (3) without causing it, when vesiculated and breathed on, to show other than a semitransparent tarnish on the surface; and this vesicle is kept as a pattern.

(5.) Another bead is now prepared in a precisely similar manner to (3), but at this point the potassic assay (as, for instance, powdered *Apophyllite*, which contains about 5 per cent of potash) is dissolved, as far as possible, in it, before the blowpipe, and *after* this fresh boric acid added, as in (4), but, unlike that, *this* bead—when vesiculated and breathed on—shows again the *pale blue film*, and the two vesicles should be observed together near a window, both by transmitted and reflected light, when the difference is very striking.

(6.) *Quantitative* results are obtained by calculating the proportion of fresh boric acid *required* to be added, as in (5), to produce the film, compared with that similarly required, after the addition of a weighed quantity of pure potassic silicate.

(7.) The *rationale* of the process seems that a small proportion of potash interferes less with the chemical character of boric acid than soda does,—as may be also concluded from the fact that a mere trace of the latter quite *orangises* its green "flame," while a considerable quantity of potash only intensifies it. Fresh boric acid must be invariably added *after* the addition of the potash, because the soda previously added seems to form a sub-alkaline borate which would take up more boric acid if the potash added did not prevent it, so that the final bead seems a double borate of sodium and potassium, on the surface of the vesicle of which the film formed by breathing on the *potassic* borate overpowers the fainter reaction on the *sodic* borate.

(8.) The blue film is due to *moisture*, and not to any possible combination (as I at one time thought) of potash with carbonic acid, as may be proved by holding a boric

acid vesicle alternately in the thick smoke emitted from ignited dry brown paper, and in steam.

(9.) The pyrological estimation of either soda, potash, or lithia, not in each other's presence, is a very simple and rapid affair, as about 5 per cent of either (and not less) will diffuse the black balls of *cobalt oxide* throughout a boric acid bead of 50 m.grms., causing it to appear, on cooling, transparent and *pink*; and from 18 to 20 per cent of alkali causes a similar bead to *remain blue* on cooling, while no oxide not alkaline (except, so far as I know, that of *Thorium*, of the curious reactions of which I will give you an account in another paper) is soluble in boric acid.

(10.) Chlorides (as common salt) will, if rapidly dissolved in a boric acid bead in presence of soda, and vesiculated, afford a blue film; and chlorine is also betrayed by the smell of the smoke arising from the red-hot bead; but after a few seconds of treatment in an oxidating pyrocone the chlorine is volatilised, and the normal reactions are as those above described.

(11.) The pyrological addition of a *considerable amount* of potash, especially caustic potash, to a boric acid bead, gives a similar reaction to the resulting vesicle as that of soda does, because an alkaline borate has been formed.

12. A *sodium* silicate, fused in small proportion with boric acid, seems to leave its silica to combine with that; but, *ceteris paribus*, *potassium* prefers silicic to boric acid.—I am, &c.,

W. A. Ross.

PS.—It is in contemplation to conduct these *boric acid* assays *on a large scale*, in which the platinum wire shall be as thick as an ordinary telegraph wire, the bead as big as a hen's egg, the internal ball (*e.g.*, that formed by lime) as big as a marble, &c., the blowing-machine and lamp or candle being of course proportionately large. Assays could then, with equal rapidity, be made of 1000 m.grms., or 15.5 grains of a substance.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—In reply to Mr. J. Carter Bell's criticism of my paper on the "Conversion" of brown into grey sulphate of ammonia, I may state—what I did not then make sufficiently clear—that the sulphate referred to was that containing sulphocyanide not sufficient to pay for the distillation with hydrate of lime. There are considerable quantities sent into the market containing 2 to 5 per cent, and such materials can be "converted" for a very nominal cost of labour and acid, and with already existing plant—conditions which manufacturers readily appreciate. Sulphates consisting mainly of sulphocyanide are in demand now for some purpose or other, and I should certainly never advise any one to treat them by my process.

Mr. Bell's statement of facts, as illustrative of the two methods, is not remarkable for accuracy. From his figures one would suppose that by my plan an enormous outlay of acid was required which by the other was quite unnecessary. The expenditure of acid in each case is the same for the yield of ammonia, the latter only varying.—I am, &c.,

A. ESILMAN,

Manchester.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—“Enquirer” asks (CHEM. NEWS, vol. xxxii. p. 225) whether the lime-mud of the causticising operation is used wet or dry? It is invariably used in the moist state, just as it is taken from the filters. It has been tried more than once to dry it, but there is no advantage—on the contrary, a great disadvantage—in doing so.

“Enquirer” may take it for granted that there is a considerable saving in using the lime-mud. Unfortunately I

cannot go into the subject now, as that will be treated on in my second paper on the “Manufacture of White Caustic Soda;” but let him consider well what it costs to use, and what it costs to throw away and to buy limestone to use in its place, or even what it costs to dry it in a separate operation. Furnace-men generally get one half-penny more per ball with one-half lime-mud.

In reply to G. P., I am not surprised that he has been unable to find a method for the complete analysis of red-liquors, &c. I could find no such a one, and had to work the subject out for myself. I have been preparing a paper at spare intervals for the last year on this subject; therefore G. P. will see I cannot now describe the details of the processes. Caustic soda works are generally too much conducted under rule-of-thumb management to require such a delicate process as this: if, however, G. P. is conducting any investigation in which the process would be of service to him, if he will describe to me privately where he has failed, I will do all in my power to aid him.—I am, &c.,

GEORGE E. DAVIS.

St. Helens, Lancashire,
November 8, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—I should be glad if Mr. George E. Davis (the author of the paper on the “Manufacture of White Caustic Soda”) would inform me how it is that in the analysis of the balls he gives there is so little sodium sulphate, while in the liquors produced there is such a very much larger quantity.

The proportion of sodium sulphate to the alkali present should not be very different in the two cases, as sulphate is not formed in the vats on lixiviation, whereas in Mr. Davis's analyses there is about nine to ten times the sulphate, in proportion to the alkali in the liquors, that there is in the balls A and B (see CHEM. NEWS, vol. xxxii., p. 176).

To be consistent with the analyses it would require every other ball made to be as bad as the C ball, the analysis of which is given alongside A and B as a warning to black-ash makers.—I am, &c.,

BLACK-ASH.

Bristol, November 3, 1875.

COMMERCIAL ANALYSTS.

To the Editor of the Chemical News.

SIR,—I observe that, after some delay, the “well-known firm of chemists” mentioned in the British Association Report on the Estimation of Potash and Phosphates, and branded by me, in a letter to you, for their refusal to disclose their analytical methods, has found an apologist signing himself “Xylo.” I shall not stop to enquire whether “Xylo” is himself connected with that “well-known firm of chemists,” nor shall I deign to bestow a word of answer to the arguments of one who cynically observes that “After all, it is not pure Science, but money-making, which is the chief object of analytical chemistry.” That remark puts “Xylo” at once out of the pale of those who have a right to be heard on matters pertaining to analytical chemistry, at least in the eyes of chemists. But with reference to a scurrilous remark of “Xylo's,” which tries to make the question a personal one of my own, I beg to tell him and your readers—1st. That I am not, as “Xylo” seems to assume, an “analytical chemist” in the commercial sense, as I have never made an analysis for a fee yet, and that, therefore, the question which I raised has no pecuniary interest whatever for me. 2nd. That I have published a good deal on analytical chemistry (as well as on many other chemical subjects), and that I have published every new analytical method of any importance upon which I have chanced to stumble during the many years of my career as a chemist.

As you, Mr. Editor, know both my name and my scientific position, you will contradict the above if you do not consider it correct.—I am, &c.,

CHEMICUS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 16, October 18, 1875.

Thirteenth Note on the Electro-Conductivity of Bodies of Medium Conducting Power.—M. Th. du Moncel.—The author examines the conductivity of such moist substances and bodies, reduced to a very fine state of division, as belong to the class of imperfect conductors. He calls attention to the fact that the inversion of the polarisation current, produced on rapidly electrifying a dielectric which has previously undergone an inverse electrification, is reproduced not merely in silicates and certain metallic ores, but also in all moist bodies, animate or inanimate, and even in the majority of liquids.

Rotatory Power of Quartz in the Ultra-Violet Spectrum.—M. Croullerois.—At the Brighton meeting of the British Association, in 1872, the author communicated the result of his researches on this subject. To effect the measurement he had recourse to the procedure of Mr. Stokes, and made use of the analytical method of MM. Fizeau and Foucault; but, notwithstanding the most favourable atmospheric conditions, it was impossible for him to carry the measurement of the rotations beyond the ray O. It is true that in his experiments the normal ultra-violet spectrum and the interference-band were seen by reflection on paper saturated with the fluorescent solution, the eye intervening only in a secondary manner in the observation of the phenomenon. When M. Soret made known to the author his fluorescent eye-piece, with which the spectrum may be regarded under the conditions of direct transmission, apparently more favourable, he pointed out to him this application of his ingenious instrument. The author has noticed, in the *Comptes Rendus* of Oct. 11, a paragraph showing that this application has been successfully tried by MM. Soret and Sarazin; but these physicists have not been able to extend their observations beyond the ray N, which shows that the absorption by transmission is still more injurious than the loss of light by epipolic dispersion.

Laws which Govern the Reactions of Direct Addition.—M. V. Markovnikoff.—When to a molecule not saturated, C_nH_mX , is added another molecular system, YZ, at a low temperature, the most negative element or group, Y, combines with the least hydrogenised atom of carbon, or with that which was already in direct connection with some negative element; but, at comparatively high temperatures, it is the element Z which fixes itself upon the least hydrogenised carbon, that is to say, that, for the same substances, the reaction takes a course exactly the opposite of the former.

Case of Oxidation of Acetic Acid in the Cold, in Neutral or Feebly Alkaline Liquids, in Presence of Nitrates and Phosphates of Soda and Potash.—M. Méhay.—Having had occasion to prepare solutions containing a mixture of acetate and nitrate of potash, the author was surprised to find—after some days, during which the liquids had been set aside—an escape of gas analogous to the process of alcoholic fermentation. The gas collected extinguished burning bodies, but was not absorbed by potassa, whence it was provisionally supposed to be nitrogen. Similar results were then obtained with salts of soda, and in presence of phosphoric acid.

Process for Artificially Cooling Considerable Volumes of Air by Contact with a Cooled Liquid.—MM. Mignon and Rouart.—The apparatus employed consists of a three-necked bottle, at the bottom of which is a layer, of 0.05 metre in thickness, of a concentrated aqueous solution of calcium chloride. The bottle is immersed in a freezing mixture: one of the necks serves for the entrance of the air, another for its exit, whilst the third serves for the insertion of a thermometer.

Chloride of Silver Battery of 3240 Elements.—MM. Warren de la Rue and H. W. Müller.—This battery is composed on the one part of 1080 elements, each consisting of a tube of glass 15.23 c. in length, and of 2160 elements formed of glass tubes of 12.75 c. in length only. All the tubes are 1.9 c. in diameter, and are closed with stoppers of vulcanised india-rubber, perforated with a hole near the edge to permit the introduction of a rod of amalgamated zinc, 0.48 c. in diameter, and 10.43 c. in length for the first 1080 elements, and 7.93 c. for the remainder. At the bottom of each tube powdered chloride of silver is placed, 14.59 grms. in weight, compressed strongly with wooden rods, a flattened silver wire having been first introduced to the bottom of the tube. The silver wires are covered in their upper part, above the chloride of silver, and up to the point where they emerge from the vulcanised stopper, with leaf gutta-percha to isolate them and preserve them from the action of the sulphur in the stoppers. The electromotor force of this battery is to that of a Daniell's battery as 1.03 to 1.

Central-Blatt für Agrikultur Chemie,
Heft 9, September, 1875.

Proportion of Dust and Saline Matter in Snow.—G. Tissandier.—Taken from *Comptes Rendus*, 1875, No. 1 page 58.

Most Convenient Method of Preserving Ice and Snow.—Prof. Segelcke and Dr. Fjord.

Composition of the Clay and Greywacke Slate of Westphalia, and of the Soils Produced by its Decomposition.—Dr. J. König.—These slates, belonging to the Devonian system, form the principal rock in an extensive district of Westphalia. A sample of the rock contains—

| | |
|----------------------------|--------|
| Ferric oxide and alumina.. | 22.759 |
| Ferrous oxide | 4.855 |
| Phosphoric acid.. .. . | 0.181 |
| Lime | 0.148 |
| Magnesia | 3.142 |
| Potash | 2.651 |

The soil formed from its decomposition contains—

| | |
|----------------------------|--------|
| Ferric oxide and alumina.. | 18.529 |
| Ferrous oxide | 2.997 |
| Phosphoric acid.. .. . | 0.147 |
| Lime | 0.297 |
| Magnesia | 2.415 |
| Potash | 2.554 |

13.194 per cent of the soil was soluble in concentrated hydrochloric, and 27.394 per cent in sulphuric acid.

Baker Guano Compared with Enderbury and Raza Guano.—Dr. C. Schumann, Dr. Heiden, and M. Voight.—Enderbury and Raza guano are superior to the true Baker guano, and may be regarded as the best raw material for the manufacture of superphosphate at present in the German market. It is impossible for the phosphoric acid when once rendered soluble to go back, and the small proportion of chloride of magnesium ensures the manufacture of a dry article.

Investigations on the Amounts of Carbonic Acid Excreted in the Breath and Perspiration by Different Animal Species under the same Conditions, and by the same Species under Different Conditions.—Dr. Pott.—The greatest amount of carbonic acid per 100 grms. of living weight is excreted by birds (4.93 grms. in six hours): next follow mammals (2.95 grms. in six hours), and then insects. Young animals excrete a proportionately greater weight than old ones.

MISCELLANEOUS.

The Royal Society.—A Royal Medal has been awarded this year to Mr. William Crookes, F.R.S., for his various chemical and physical researches, more especially for his discovery of Thallium, his investigation of its compounds and determination of its atomic weight, and for his discovery of the Repulsion referable to Radiation. The other awards are—The Copley Medal to Prof. A. W. Hofmann, F.R.S., for his numerous contributions to the science of Chemistry, and especially for his researches on the derivatives of Ammonia; A Royal Medal to Dr. Thomas Oldham, F.R.S., for his long and important services in the science of Geology. It is hoped that Dr. Hofmann may be spared from Berlin for a few days, so as to receive the medal in person. The medals will be presented at the Anniversary Meeting of the Society, on the 30th inst.

MEETINGS FOR THE WEEK.

SATURDAY, Nov. 13th.—Physical, 3.
WEDNESDAY, 17th.—Meteorological, 7.
Geological, 8.

THURSDAY, 18th.—Chemical, 8. "Ethyl-phenyl Acetylene," by T. M. Morgan. "On the Presence of Liquid Carbon Dioxide in Quartz Cavities," by W. N. Hartley. "Addendum to the paper entitled 'Monthly Examination of the Harrogate Spas 1872,' by R. H. Davis. "On certain Bismuth Compounds," by M. M. Pattison Muir. "On the Formation of Coumarins, Coumaric, and other similar Acids," by W. H. Perkin. "Communications from the Laboratory of the London Institution: (a) 'On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol,' (b) 'Note on the Action of Nitric Acid on Tri-bromo-phenol,'" by H. E. Armstrong. "On Narcotine, Cotarnine, and Hydro-cotarnine," by G. A. Beckett and Dr. Wright. "On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by Dr. Gladstone and Mr. Tribe.

TO CORRESPONDENTS.

ERRATA.—Vol. xxxii., page 219, lines 27 and 30 from top, for "N" read "U."

A Subscriber to the CHEMICAL NEWS.—Consult Wagner's "Chemical Technology," published by J. and A. Churchill.

H. Payne.—The better way will be to send the Act of Parliament.

P. Clavel.—We do not know of any.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums received or promised since the 4th instant:—

| | |
|-------------------------------|-----------------------------|
| J. Williams £2 2 0 | G. Vacher £5 0 0 |
| M. J. Lansdell 1 1 0 | Prof. Odling 3 3 0 |
| Prof. Balfour Stewart.. 2 2 0 | J. B. Hannay.. .. 1 1 0 |
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| W. H. Balmain 1 1 0 | G. T. Glover.. .. 1 1 0 |
| Dr. R. Fresenius 2 0 0 | Priest and Son 0 10 6 |
| Prof. Heaton.. .. 1 1 0 | Dr. Angus Smith.. .. 3 3 0 |
| H. Watts 2 2 0 | J. Mason.. .. 5 0 0 |
| Dr. Letheby 2 2 0 | Dr. Longstaff.. .. 2 0 0 |
| W. M. Henry 5 0 0 | W. Thomson.. .. 2 2 0 |
| R. J. Friswell 1 1 0 | Sidney Lupton 1 1 0 |

The Committee will gladly receive further contributions.

ALFRED TRIBE, Hon. Sec.

Royal Institution, London, W.,
November 9th.

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NOTICE.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 834.

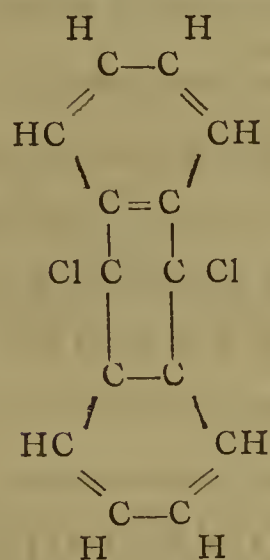
ALIZARIN FROM ANTHRACEN-SULPHO-ACID.

By G. AUERBACH.

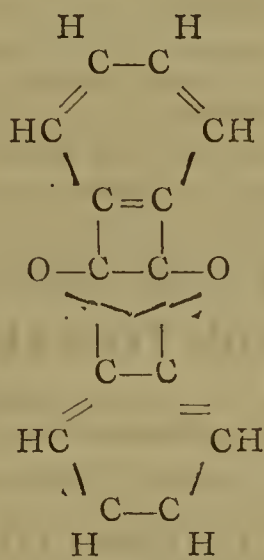
AMONGST the patents taken out up to the present time for the manufacture of artificial alizarin there are three by which one obtains anthraquinon-sulpho-acid by oxidising anthracen-sulpho-acid. It is thought that these methods simplify the old methods (oxidation of anthracen into anthraquinon), and are not used because our raw materials are not to be obtained pure enough; but, I think, if we could obtain in quantity a chemically pure anthracen, it would not be theoretically possible to obtain alizarin by these methods.

My reasons for thinking so are the following:—

If anthracen is treated with chlorine, one obtains a body which contains, instead of two hydrogen atoms, two atoms of chlorine (dichlor-anthracen). With any oxidising agent—chromic acid, peroxide of manganese, &c.—we obtain chlorine and anthraquinon; therefore we see that chlorine is eliminated and oxygen takes its place, which shows that the chlorine in the dichlor-anthracen must take the place of the oxygen in the anthraquinon, as the following formulæ shows:—



Dichlor-Anthracene.



Anthraquinon.

If we treat this dichlor-anthracen with sulphuric acid, we first obtain, as Perkin shows, a dichlor-sulpho-anthracenic acid, which, by further treatment with sulphuric acid, oxidises the chlorine atoms, oxygen takes the place of chlorine, sulphurous acid is given off, and we obtain anthraquinon-bisulpho-acid.

If we oxidise anthracen-sulpho-acid, we do not get anthraquinon, but an anthraquinon-sulpho-acid. We have no reason to think that sulphuric acid takes any other place in the anthracen than the chlorine, and that, in oxidising anthracen-sulpho-acid, the sulphuric acid changes its place for oxygen. On the contrary, the oxygen must have another position in this anthraquinon-sulpho-acid than in that obtained by treating anthraquinon with sulphuric acid. The first anthraquinon-sulpho-acid cannot be identical, but only isomeric, with the anthraquinon-sulpho-acid obtained from anthraquinon and sulphuric acid. One does not obtain alizarin from one of these methods; one obtains red sulpho-salts, and, by melting with potash, a violet melt, which, after precipitation, contains only slight traces of colour, and settles, after standing, as a dark brown smear, which melts under water and is also soluble in water.

Greenford Green, Harrow,
Middlesex.

NOTE ON A CORNISH SPECIMEN OF WAVELLITE.*

By J. H. COLLINS, F.G.S.

THE mineral wavellite, a hydrous phosphate of alumina, is of considerable interest to the mineralogist, although it has not hitherto occurred in such quantities as to be commercially valuable as a source of phosphoric acid. It was originally discovered by Mr. J. Hill, of Tavistock, about the year 1785, by whom it was found in rounded concretions resting upon clay-slate at Filleigh, near Barnstaple. It was about thirty years later analysed by Dr. Wavell, and named after him. It has also occurred in Northumberland, Scotland, Ireland, and many foreign localities—usually upon clay-slate or sand-stone.

Its occurrence in Cornwall has been several times reported and as often disputed. Thus in Greg and Lettsom* at page 80, it is said to occur on a decomposing granite at Stenna Gwynn, near St. Austell, often accompanied with fluor and the rare mineral fluellite.

I have now the pleasure of corroborating this statement, and of presenting to the Royal Institution of Cornwall a small specimen from that locality, which was lately placed in my hands for analysis by Mr. Richard Talling, of Lostwithiel, from whom also Messrs. Greg and Lettsom had their information. I was not able to use more than 1½ grains for this purpose, but, although this was not enough to allow of a quantitative analysis, I was able very well to determine the presence of all the essential constituents of wavellite. It will be seen that the specimen is really upon a granite rock, unlike the specimens from other localities, but it is not, I regret to say, in this instance, associated with the extremely rare fluellite.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.†

By Dr. A. W. HOFMANN.

(Continued from p. 231.)

BALLOONING had been made subservient to the purposes of meteorology and physics before it was enlisted in the service of the war-spirit. Charles utilised his expedition for scientific purposes. On July 18, 1803, he was imitated by Robertson, who ascended from Hamburg to the height of 7400 metres, and who imagined that he perceived at this altitude a decrease in the intensity not merely of terrestrial magnetism, but also of frictional electricity. These statements induced the great physicists Biot and Gay-Lussac to undertake two ascents the next year. They refuted the above-mentioned views of Robertson, remarked the decrease of atmospheric moisture with increasing altitude, and made numerous and valuable meteorological observations. From the greatest height which they attained, 6500 metres, Gay-Lussac brought back a specimen of air, and found that it had the same composition as the air of lower regions—a result, at that time, of capital importance. The last-mentioned ascents were all made with hydrogen gas. As the use of gas-lighting became more and more general the greater power which the lightest of all known bodies offers was sacrificed to the convenience which coal-gas afforded. In France, Barral and Bixio made their scientific ascent in 1850 with the aid of coal-gas. In England Glaisher adopted the same plan in 1864, and the numerous balloon voyages which have been made for the amusement of the public from the love of adventure or for some especial purpose, have been undertaken with the same material. With

* From the *Journal of the Royal Institution of Cornwall*.

† "Manual of the Mineralogy of Great Britain and Ireland."

‡ "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

coal-gas Green travelled in sixteen hours from London to Weilburg, in Nassau, in 1836; Flammarion and Godard in 1867 from Paris to Solingen, performing 70 German miles in twelve and a half hours. Nader, who hoped to take photographic maps whilst floating in the air, had filled his balloon "Le Géant," with 6000 cubic metres of coal-gas, on his somewhat dangerous journey from Paris to Hanover, October 18, 1863. More recently aëronauts have returned to the use of hydrogen. But even in those four months of the greatest siege of a metropolis of which history bears record, when Paris depended exclusively for its intercourse with the outer world upon carrier pigeons and balloons, which had never before been called to so important a service, even then necessity compelled the use of coal-gas because it was procurable with the least difficulty.* 65 balloons went up from Paris between September 28 and January 22, carrying 91 passengers, 363 pigeons, and 2½ million letters, and for the most part with success. Only 5 balloons fell into the hands of the German armies: one descended in Munich; another at Wetzlar; one disappeared entirely, perhaps in the sea; whilst the fragments of another were found in the autumn of 1873 clinging to a tree at Port Natal in south-eastern Africa. All the others descended safely beyond the radius of the besieging army in France or upon neutral territory: one in Belgium; three in Holland; and one upon a snow-field in Norway, 60 (German) miles to the north of Christiania, and 180 from Paris, which had been traversed in fifteen hours.†

(To be continued)

ON THE ACTION OF SULPHOCYANIDES ON PALLADIUM CHLORIDE AND NITRATE.

By SERGIUS KERN, St. Petersburg.

PALLADIUM chloride is used sometimes as a reagent for the detection of iodine, giving palladium iodide (PdI_2) a black precipitate insoluble in water; this reaction is a very delicate one. Studying the action of alkaline sulphocyanides on some metallic compounds of the platinum group, I observed that by mixing aqueous solutions of palladium chloride and potassium or ammonium sulphocyanide a soluble palladium sulphocyanide is formed; the liquor, meanwhile, from a reddish-brown colour turns red.

The resulting sulphocyanide of palladium is a very stable compound, in which the presence of the palladium is not easily detected. Thus an alcoholic solution of iodine gives no black precipitate of palladium iodide. Palladium nitrate [$\text{Pd}(\text{NO}_3)_2$] with potassium sulphocyanide also yields palladium sulphocyanide.

Palladium chloride being often used in qualitative analysis for the detection of iodine, and palladium nitrate for the separation of iodine from chlorine and bromine, it is easily understood from this small research that the presence of sulphocyanides in the analysed liquors must be avoided, because if they are present faulty results may be obtained.

THE CHEMICAL CONSTITUTION OF THE CHLORINATED METHYL & ETHYL ETHERS, AS ALSO OF THE CHLORINATED COMBINATIONS OF THESE ETHERS WITH FORMIC, ACETIC, OXALIC, AND CARBONIC ACIDS,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

My researches into the chemical constitution of the ethyl ether and its chlorinated derivatives have culminated in a

new theory, which, supported as it is by a host of well-established facts, will not be deemed unworthy of an attentive and minute examination. Prompted by a natural desire of more fully developing and substantiating that theory, I have not been slow in gathering a second abundant crop of valuable observations, with the aid of which I hope in the sequel to throw a bright and powerful light upon certain intra-molecular changes and typical metamorphoses which chlorine, in its capacity of a substitutional reagent, is held to superinduce upon the particular group of organic molecules that forms the theme of the coming remarks.

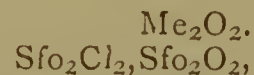
In projecting my programme, I have found it advisable to divide the chloro-derivatives of the ethers before us into two separate classes. The first class is made to comprise all those chloro-derivatives in which the number of still replaceable hydrogen molecules amounts to one, or more than one; while the second class is made to comprise those chloro-derivatives in which the whole of the component hydrogen molecules has been replaced by an equal number of chlorine molecules.

Accordingly, my programme will consist of the following two parts:—In the first part, I shall expound the molecular changes attending the formation and transformation of that set of chemical compounds which fall under the first class of chloro-derivatives; and in the second part I shall expound the molecular changes attending the formation and transformation of that set of chemical compounds which fall under the second class of chloro-derivatives. With these few statements, I shall now call upon the reader carefully to ponder the contents of the first part of my programme.

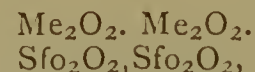
PART I.

On the Principal Molecular Changes attending the Formation and Transformation of that Set of Chemical Compounds which fall under the First Class of Chloro-Derivatives.

A. *Chloro-Derivatives of the Methyl-Ether.*—Taking it for granted that the action of chlorine on this ether is precisely similar to its action on the ethyl-ether (*vide* CHEMICAL NEWS, vol. xxxi., p. 245), the chemical constitution of the mono-chloro-methyl-ether will be expressed by the formula—

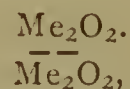


which represents it as the mono-methyl-ether of the biatomic methyliden-oxychloride. It would be easy to test the correctness of this view by treating the ether with sodium-methylate, when the resulting product ought to be methylal—

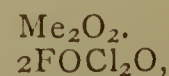


which is an ethereal liquid occurring among the distillation products of pyroxylic spirit with oil of vitriol and peroxide of manganese.

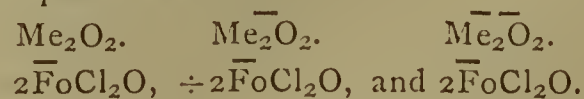
Passing on to the dichloro-methyl-ether, its formula will be—



if we suppose the molecular changes to consist in the substitution of a molecule of chlorine for one of hydrogen in the regenerated chloro-methylen adjunct. This compound, again, after merging into the isomeric modification—



would then, by the further action of chlorine, produce in succession the tri-, tetra-, and penta-chloro-methyl-ethers, with the respective formulæ—

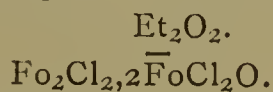


It remains to be seen to what extent these theoretical anticipations are verified by future experiments.

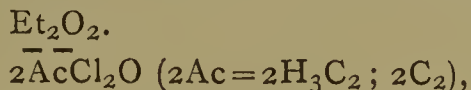
* Saint-Edme, "La Science pendant le Siège de Paris," 1871, 62.

† Stephan, *Weltpost und Luftschiffahrt*. Berlin, 1874.

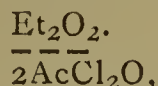
B. *Chloro-Derivatives of the Ethyl-Ether*.—In the paper above referred to I have already had occasion to enlarge on the first four chloro-derivatives of the ethyl-ether, to the last of which I assigned the formula—



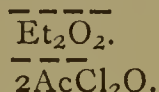
Assuming that, under the stimulus of chlorine, this compound is first made to merge into the isomeric modification—



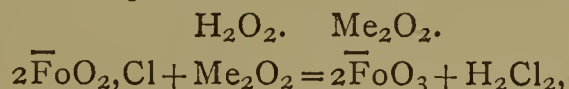
the interchange of chlorine for hydrogen in the regenerated dichloro-methyl adjunct will give rise to the penta-chloro-ethyl-ether—



clearly showing that henceforth the substitutional action of chlorine will be confined to the ethylen adjunct of the ether base. Passing over the intermediate substitution-products, we arrive at the last member of our series, viz., the ennea-chlorethyl-ether, the chemical constitution of which will be adequately expressed by the formula—

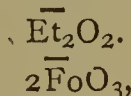


A. (1). *Chloro-Derivatives of Methylic Formate*.—So far as I am able to gather, not a single one of the possible chloro-derivatives of this ether-salt has yet been obtained in a fit state for analysis; it is, however, worthy of notice that the methylic chloro-formate may be got synthetically, that is, by the action of phosgen on methylic alcohol, according to the equation—

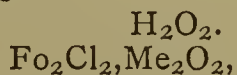


where it is plain that the molecular changes consist in the interchange of methoxyl for chlorine.

B. (1). *Chloro-Derivatives of Ethylic Formate*.—Like the preceding compound, the ethylic chloro-formate has been got by synthesis only, viz., by the action of phosgen on ethylic alcohol. Among the other possible varieties, I may mention the chlorethylic chloro-formate—

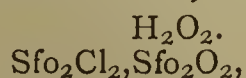


which, with solution of potash, gives formate and acetate. In this metamorphosis, the newly-formed chlorethylic alcohol is first made to merge into the isomeric hydrate of ethylden-oxychloride—



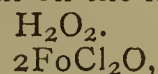
whereupon the two molecules of hydrogen, which the alkali has helped to expel from the methylen adjunct, by acting substitutionally on the chlorine adjunct of the chloroformate, give birth to a molecule of formate. At the same time, the newly-formed chloraldehyd becomes oxidised into chloracetate at the expense of 2 molecules of water, while the liberated hydrogen, by its substitutional action on the chloracetate, effects its conversion into acetate.

A. (2). *Chloro-Derivatives of Methylic Acetate*.—There exists a dichloro-derivative, which may be viewed as chloro-methylic chloracetate or as dichloro-methylic acetate. With potash-lye this compound is observed to resolve itself into formate and acetate, through the following series of molecular changes. In the first view, the newly-formed chloro-methylic alcohol, after passing into the isomeric hydrate of methyliden-oxychloride—



splits up into hydrochloric acid and formite of water (formaldehyd), which then becomes oxidised into formate

at the expense of 2 molecules of water, while the liberated hydrogen transforms the chloracetate into acetate. In the second view, it is clear that the formate must be due to the action of the alkali on the isomeric modification—



of the newly-formed dichloro-methylic alcohol; but, as regards the acetate, the reason of its occurrence is sufficiently obvious and self-evident. There exists also a trichloro-derivative, which may be viewed as dichloro-methylic chloracetate or as chloro-methylic dichloracetate. The decomposition products of this compound by solution of potash are formate and an oily matter, which, by its formula, Fo_2Cl_2 , is evidently formyl-chloride, both these substances being set at liberty by the splitting up of the pre-existing (first view) or newly-formed (second view) chloracetate into its two principal components. It is, further, clear that the second molecule of formate must derive from the newly-formed dichloro-methylic alcohol (first view), or else from the formite of water (second view), in the manner previously explained.

B. (2). *Chloro-Derivatives of Ethylic Acetate*.—Under this head, I shall notice, first, the chlorethylic chloracetate, which, with solution of potash, gives 2 molecules of acetate, where the molecular changes consist successively in the splitting-up of the newly-formed chlorethylic alcohol into the isomeric hydrate of ethylden-oxychloride, the expulsion of 2 molecules of hydrogen from the methylen adjunct, and their substitutional action on the chloracetate, with formation of acetate; while the other molecule of acetate derives from the simultaneously-generated chloraldehyd, as explained under B. (1). I shall, further, notice the dichlorethylic chloracetate, which, with solution of potash, is said to furnish acetate, chloracetate, and an oily matter that, from its probable identity with the before-mentioned formyl-chloride, ought to be accompanied by a corresponding quantity of formate. The reader, by taking his cue from the preceding explanations, will not be at a loss to trace the molecular changes of this interesting, but, as yet, imperfectly investigated reaction. Passing over the tetra, penta, &c., chloro-derivatives, regarding which little is known beyond their empirical formulæ, it will be more expedient to review *en masse* the compounds falling under the sections A, 3 ÷ B, 3 ÷ A, 4 ÷ B, 4, and which comprise the chloro-derivatives of the methylic and ethylic oxalates and carbonates. From the circumstance that the replaceable hydrogen molecules are all contained in the hydrocarbon adjunct of their respective ether bases, I am led to anticipate that the decomposition-products of the primarily-formed chloro-methylic and chlorethylic alcohols will consist of the aldehyds and acids that are moulded on the formyl-, acetyl-, and glycolyl types.

In commenting on the class of chloro-derivatives before us, I may observe that they have all this important feature in common, that during the many and divers phases of substitutional metamorphosis they have each and all continued to preserve the original type of ether-salt molecules, and this up to the point, when there is spared to them but one single molecule of hydrogen. Now I have no hesitation in maintaining that that particular hydrogen molecule has all along withstood the substitutional attacks of chlorine, simply and solely because it has never ceased to discharge in these molecules the well-defined duties and functions of a basic hydrogen nucleus. And here the reader will not fail to recall one of the chief characteristics of all basic nuclei, to wit, that the chemical materials out of which these nuclei are formed are invariably taken from among the electro-positive metals; and, furthermore, that, while such basic nuclei are constitutionally qualified to exchange places with one another, they are absolutely incapable of transposing with non-metallic elements, like chlorine, for example.

Having now impressed the reader with the deep import of these theoretical distinctions, I shall invite him to accompany me to the second part of my programme

where I purpose enquiring into the special terms and conditions on which the last remaining molecule of hydrogen becomes freely replaceable by chlorine, so as to give birth to our second class of chloro-derivatives, wherein the original type becomes completely obliterated and supplanted by another and totally different type, it being experimentally demonstrable that the thus altered molecules have passed from the category of organic ether-salts into the category of anhydrous organic acids.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 13th, 1875.

Professor GLADSTONE, F.R.S., President, in the Chair.

THE PRESIDENT stated that since the last meeting of the Society Professor Everett's important work, "On the Centimetre-Gramme-Second System of Units," had been published by the Society. The book is based on the recommendations of a Committee of the British Association, and consists of a collection of physical data concisely presented on the above system, a complete account being added of the theory of units.

Dr. STONE then read a paper "On Thermopiles." He has recently been engaged in some experiments with a view to ascertain the best alloy for use in thermopiles. The thermo-electric power of a metal or alloy appears to be quite unconnected with its power for conducting heat or electricity, or with its voltaic relation to other metals, neither does it appear to have any relation to specific gravities or atomic weights. The thermopiles employed were of a form slightly modified from that employed by Pouillet in his demonstration of Ohm's law. Alloys are frequently more powerful than elementary metals; thus, 2 parts of antimony and 1 part of zinc have a negative power represented by 22.70, while that of antimony is 6.96 or 9.43, and that of zinc is 0.2. A strange exception, however, is that of bismuth and tin; for, while the power of pure bismuth is +35.8, when the two metals are alloyed in the proportion of 12 to 1, the power becomes -13.67. Dr. Stone first used a couple consisting of iron and rich German silver (that is, rich in nickel). This was characterised by great steadiness, but the electromotive force produced by moderate differences of temperature was not great. He then used Marcus's negative alloy, consisting of 12 parts of antimony, 5 of zinc, and 1 of bismuth, but the crystalline nature and consequent brittleness of this mixture were found to be great objections to its practical use. It occurred to Dr. Stone that the addition of arsenic might diminish the brittleness without injuring the thermo-electric power; and, on trial, it was found that an alloy of zinc, antimony, and arsenic, with a little tin, formed a much less brittle mass than Marcus metal, with quite as great, or greater, thermo-electric power. A set of twelve couples of this alloy and German silver was exhibited. The electromotive forces of this set, and of a similar one of 12 iron and German silver couples, were determined by Mr. W. J. Wilson, and found to be, for one alloy and German silver couple, with difference of temperature of 80° C., $\frac{1}{108}$ th of a Daniell's cell. The electromotive force of one couple of the iron and German silver set was $\frac{1}{648}$ th of a Daniell's cell. The ordinary method of applying heat by a trough of hot water is objectionable, for the water short-circuits some of the current. This is evident from the fact that, if oil heated to the same temperature be substituted, a considerably greater deflection is obtained. Another method suggested by the author, which would tend to economy, is to allow petroleum to volatilise in the neighbourhood of one face of the pile, thus chilling it, and

to ignite the mixture of air and gas so produced at the other face. Clamond's pile, consisting of iron and an alloy of zinc and antimony, was employed for some time, but, although good results were obtained, the iron is liable to rust at the connections.

Dr. GUTHRIE remarked that, in researches of this nature, the main object in view was to ascertain what relation, if any, existed between the direction of the current and the amount of heat flow. He referred to the experiment with a tangle of fine platinum wire, by which it is found that, if either end of the wire be heated, a current flows towards the tangle, and this takes place however well the tangle may be annealed. He suggested that the great effect which alloying one metal slightly with another has on its position in the thermo-electric series may, perhaps, be connected with its change in conducting power for heat.

Mr. WALENN referred to experiments which he made couple in which amalgamated copper was employed, some years since on thermopiles when used at high temperatures. The most powerful currents were obtained with a but the power was soon lost, in consequence of the volatilisation of the mercury. Subsequently, he employed wires of wrought-iron and German silver, and, although the results were not specially remarkable at moderately high temperatures, the power became great when the connections were raised to a red heat.

Professor FOSTER called attention to Matthiessen's "Table of the Electric Conductivities of Metals and Alloys," in relation to the use of the latter in thermopiles. The fact shown by Matthiessen, that the conductivities of alloys are greatly influenced by changes of temperature, will probably, he considers, be found to have some connection with their thermo-electric action. He also mentioned, as a fact which should be remembered when considering the construction of thermopiles, that the presence of minute traces of impurity completely changes the electric conductivity of a metal.

SOCIETY OF PUBLIC ANALYSTS.

OBSERVATIONS ON THE MILK OF THE COW IN DISEASE.

By A. WYNTER BLYTH, F.C.S.,
Analyst for Devon.

1. *Eczema Epizootica.*

It has long been observed that in both our own epizootics of foot and mouth disease, as well as in those of Germany and the Continent, that the milk of the cow during the first three days of the malady is occasionally fatal to calves and pigs,* and recent experiences have fully confirmed this fact, at once curious and important.

This fatality is by no means uniform, and only occurs in a few cases, but in all the symptoms are remarkably similar. The animal in the midst of apparent health, is as suddenly taken ill, and the illness is as immediately followed by death, as if a fatal dose of a violent poison had been administered.

If the pathological changes found after death afford us little insight into the mystery of the attack itself, they at all events show the immediate cause of death, which is suffocation.

I have recently had an opportunity† of observing the *post mortem* appearances in a calf which thus died after suckling its mother, with extreme suddenness. The base of the tongue and the larynx was intensely swollen and congested, the bronchial tubes were completely choked by a viscid frothy mucous, the true stomach was deeply congested as well as the kidneys, and the intestines were of a rose

* *Comptes Rendus*, Zurich, 1846; Petri, *Annales des Bruxelles*, 1843

† Through the kindness of Mr. Gregory, M.R.C.V.S., Bideford

Colour; there were also a few aphthous patches on the tongue.

It would, then, appear that the warm milk acts first as a local irritant, and then the specific germ of the disease is carried into the blood, and determines to the lungs, kidneys, and tongue: the gorged kidneys no longer fulfil their office of depuration; there is an excessive outpour of fluid into the bronchial tubes; and the animal dies, for the most part suffocated, but partly also from the impure blood circulating in the nervous centres.

With regard to the milk itself, which is thus so suddenly converted from Nature's nourisher to Nature's destroyer, the whole of the knowledge which we at present possess upon the subject may be summed up in two brief sentences.

(1). The milk mostly, but not invariably, contains abnormal microscopical elements of unknown significance.

(2). The milk mostly, but not invariably, yields to analysis percentages of its components which differ from those of healthy milk.

(1). *Microscopical Characters*.—If milk be taken on the first day of the disease, and microscopically examined, no abnormal elements whatever may be discovered in it; but, on the other hand, instead of the milk globules remaining free and separate, as is usually the case, they show a tendency to aggregate into groups; in other words, the first stage is *aggregation of the milk corpuscles*. About the third day some new elements, not hitherto described, make their appearance. These consist of elongated, flattened, highly refractive bodies, ranging in length from 1-800th to 1-1000th of an inch. In some there are contractions at intervals, which at first sight might be mistaken for a division into cells, but this is not so; it would rather appear to be the contraction of a sarcode (?) material. These bodies are not perceptibly altered by dilute acetic acid or by iodine, nor are they stained by magenta. I have had no opportunity of ascertaining whether, whilst the milk is warm and fresh from the cow, any movement indicative of animal life is to be observed in them. On the fourth day, if they have not entirely disappeared, they are very few in number, and somewhat increased in size. These bodies are not found in the milk of the later stages.

After the third day, and continuing in some cases for a period of a week, or even much longer, pus cells, large granular bodies, vibriones, bacteria, epithelial-like cells, and *débris* are very constantly seen. I believe most of them are obtained by the dropping of the discharges from unhealed ulcers on the teats of the animal into the milk.

Composition of the Milk.—The following table well illustrates the varying characters of the milk. It will be noticed that in some instances the fat may be said to be almost entirely absent. This deficiency of fat may continue for at least a week, and may be associated with a deficiency of caseine and a deficiency of salts; hence the *milk solids not fat* may fall below 9.0 per cent, a fact which must not be distorted by interested persons to apply in any way to normal milk: I am writing here of a product which is profoundly altered. The percentage of milk-sugar is sometimes much increased, but, as a rule, it is but little affected. All the analyses quoted are those of milks taken in each case from different animals:—

NOTICES OF BOOKS.

Discoveries and Inventions of the Nineteenth Century.

By R. ROUTLEDGE, B.Sc., F.C.S. London: G. Routledge and Sons.

THE object of this volume, as the title explains, is to give an account of some of the discoveries and inventions which have characterised the present century. To have given an account of all would have been manifestly impossible, and a selection has therefore become necessary. It seems to us, however, that the author has given too much prominence to mechanical and engineering performances, and given a subordinate place to chemistry. We certainly think that the modern development of the alkali manufacture, with its collateral branches, the preparation of artificial manures, the production of artificial ultramarine, the discovery of the Stassfurt salts, the industrial applications of chrome, the introduction of animal mordants, the isolation of quinine, and indeed many more discoveries that might be mentioned, have had quite as much "direct bearing on the general progress of our age" as "Pepper's ghost." Yet while such a trifle occupies four pages and as many illustrations, the subjects above mentioned have not been thought worthy of mention.

Light-houses, coal, gold, and diamonds, however important, can scarcely be claimed as the exclusive property of the nineteenth century.

With these exceptions the book may be pronounced a creditable performance. The descriptions are clear, and, as far as we have observed and are capable of judging, correct. The information given is conveyed in an easy and familiar style which will commend itself to a large section of the public. It has been the author's aim not to assume on the part of his readers any knowledge not usually possessed by young persons of either sex who have received an ordinary education. The most ambitious, and perhaps the most truly valuable portion of the work, is an attempt to give a popular view of the doctrines embodied in Sir W. Grove's "Correlation of Physical Forces." The author is quite right in supposing that no attempts have yet been made to introduce these important truths to outsiders. Their profound significance and great educational value require that they should be made known far beyond professional and scientific circles, and we are well pleased that Mr. Routledge has taken the task in hand. His exposition of the conservation of energy is clearly and ably drawn up, and is illustrated by frequent reference to facts brought forward in earlier portions of the work.

The book is handsomely got up, profusely illustrated, and provided with a copious index.

Magic Lanterns: How Made and How Used. By A. A. WOOD, F.C.S. London: C. G. Wood, 74, Cheapside.

THE appearance of this little book warns us of the approach of Christmas. The magic lantern in skilful

| | Water. | Fat. | Caseine. | Milk-Sugar. | Ash. | Solids no Fat. |
|--|--------|-------|----------|-------------|-------|----------------|
| Average of healthy milks | 87.550 | 3.070 | 4.160 | 4.760 | 0.730 | 9.650 |
| Milk from a cow on the 1st day of the disease .. | 91.239 | 0.390 | 2.899 | 4.809 | 0.563 | 8.371 |
| „ „ „ 2nd day „ .. | 79.903 | 5.010 | 14.380 | | 0.707 | 15.087 |
| „ „ „ 2nd day „ .. | 86.320 | 3.838 | 9.135 | | 0.707 | 9.842 |
| „ „ „ 3rd day „ .. | 87.676 | 0.891 | 3.948 | 7.152 | 0.333 | 11.433 |
| „ „ „ 4th day „ .. | 83.852 | 7.798 | 3.469 | 4.669 | 0.212 | 8.350 |
| „ „ „ 5th day „ .. | 87.900 | 1.062 | 10.376 | | 0.662 | 11.038 |
| „ „ „ 7th day „ .. | 86.067 | 1.587 | 10.849 | | 0.507 | 11.356 |
| „ „ „ 14th day „ .. | 83.882 | 3.961 | 11.478 | | 0.679 | 12.157 |

hands may be made to afford an almost exhaustless fund of amusement, and at the same time much much valuable instruction. All persons who calculate upon displaying this instrument under any of its modifications, whether in private or in public, will find here full and intelligible instructions for its management. We notice here also a brief biographical notice of Henry Langdon Childe, the inventor of dissolving views and of the chromatrope.

There is an interesting selection of chemical, optical, magnetic, and galvanic experiments arranged for exhibition to an audience by projection on the screen.

Among the list of "subjects for lectures" to be illustrated by the magic lantern the author proposes "The North Pole and how to get there." This theme, we should think, will be much easier to handle when some one has actually got there and has given us an account of his experience.

Annual Report of the Director of the Mint for the Fiscal Year ended June 30, 1874. Washington: Government Printing-Office.

THIS report contains much curious information on monetary standards, on the amount of gold and silver coin and bullion in the world, and the coinage laws of all nations.

The most interesting portion, in a scientific sense, is the report of Mr. W. E. Dubois on the spectroscopic assay of gold alloys. The results, as obtained by Mr. A. E. Outerbridge, an experienced and skilful spectroscopist, are unfavourable. Where two metals are present the electric spark chooses for its vehicle the one which is most rapidly vapourised. Hence, though $\frac{1}{1000}$ th of a milligramme of gold will show a spectrum—when the gold is pure—in an alloy of silver and copper containing 3·8 per cent of gold, the latter is not indicated by the spectro-scope at all: 20 per cent of nickel in an alloy of nickel and copper is likewise not detected. Another of the Mint assayers, Mr. H. G. Torrey, likewise reports that—"The lines are not of uniform width from end to end, but run to a point and fade out so gradually that the point of termination is by no means certain. An unequal delivery of the spark involves inequality in the length and brightness of the lines. The lengthening or shortening of the lines does not correspond with the increase or decrease of the proportion of precious metal present." The want of absolute homogeneity in the plates and ingots to be assayed would also constitute a serious difficulty, even if every other objection could be removed. Hence the writers consider that the success of quantitative spectroscopic analysis can scarcely be anticipated.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—The following correspondence is a painful instance of how analytical chemists differ. It is really most sad and humiliating to our splendid science to think that, with all the improvements with which chemistry has been enriched within the last few years, true analytical work has not kept pace with the spirit of the age, or we should not find such great discrepancies in the works of those that follow the practice of analytical chemistry. "Who shall decide when doctors disagree?" When each chemist pursues his own method of working, which, in some instances may be erroneous, instead of adhering to some recognised plan, the question arises, Who is to decide between the conflicting methods now in use? Surely no

better authority could we have than the Chemical Society. Let that body select a practical jury of twelve, to decide upon special processes for analytical work; let a compound or well-known composition be given to the jury to analyse; then, if they one and all return the analyses according to the composition, we may safely infer that the process by which such results have been brought out is a good one, and that in future compounds must be analysed by the particular method selected. And if chemists would adhere to the rules laid down, perhaps then we should not hear of such a discreditable case as the following, where five chemists analyse a water, and three report it good and two very bad:—

Some time since, the directors of a large institution near London sank a well between three and four hundred feet deep. When finished, the water was analysed, and pronounced by chemist A to be good. In June of this year the directors thought fit to have the water again examined; it was now analysed by a noted commercial analytical firm, B, who condemned the water. This report alarmed the directors, and they again, in the same month, sought the aid of another chemist, C, who was an M.D. The water was condemned in still stronger terms. Things were now looking serious; but, before the directors closed the well, over which they had spent a large sum of money, they decided, in July, to have the water analysed by chemist D. The report received was most favourable; still they were in as great a difficulty as ever, because two reports gave the water as good, and two as bad. They were now obliged to make an appeal to chemist E, so that the balance of evidence might be upset. The report was again good.

Below, I give the reports and analyses of the five chemists:—

A.

I beg to report to you the result of my analysis of the sample of water sent to me.

The water is bright, free from colour, and remains perfectly good after prolonged keeping.

One imperial gallon contains in solution 27·5 grains of solid matter. The solid matter is composed as follows:—

| | Grains in Gallon. |
|--|-------------------|
| Carbonate of lime | 15·800 |
| Carbonate of magnesia | 0·800 |
| Sulphate of lime | 6·500 |
| Silica | 0·600 |
| Chloride of sodium | 1·300 |
| Nitrates of the alkalies and organic matter | 2·500 |
| | <hr/> 27·500 |

Hardness in its natural condition 23·0
,, after boiling for half-an-hour 7·0

The water exerts no action on metallic lead, and may therefore, be safely kept in leaden cisterns.

The ammonia in the water is extremely small, and the organic matter present is almost entirely in the oxidised, or non-putrescible condition. The small amount of chlorides indicates that little or no organic contamination of an animal origin finds access to the well.

I am of opinion that the water is of good quality, and well suited for drinking, cooking, or domestic purposes. Nevertheless, it is probable that the organic matter in the water will vary within certain limits, both in quantity and quality, and I should, therefore, recommend that, for drinking purposes, the water should be regularly filtered through animal charcoal.

B.

We hereby certify that we have examined the sample of water described below, and that the following is the result:—

| | Grains, Imperial Gallon. |
|----------------------------|--------------------------|
| Carbonate of lime | 17'050 |
| Sulphate of lime | 0'500 |
| Nitrate of lime | 1'900 |
| Nitrate of potash | 0'400 |
| Nitrate of soda | 1'200 |
| Muriate of magnesia.. .. . | 1'050 |
| Silica | 0'700 |
| Organic matter | traces |
| | 22'800 |

We beg to enclose analysis of the sample of water. From this analysis we are of opinion that most probably it is surface-water, as it contains flocculent organic matter as well as organic matter dissolved in it. It is certainly not contaminated with sewage-matter, as, if this was the case, the percentage of muriate of soda would be very much larger. The percentage of nitrates is not large, and they are present in consequence of the water being, at any rate partially, collected from fields where nitrates have been used for manure. Taking all these circumstances into consideration, we are of opinion that this water is not suitable for drinking, as at certain seasons of the year, owing to the fields being dressed with manure, it would become far more impure; and we should strongly advise the directors to obtain their drinking-water from another source. Filtration would get rid, of course, of the flocculent organic matter, but would have no effect on the organic matter in solution.

C.

Analysis of water sent in a stone jar, corked and sealed:—

| | |
|------------------------------|--------------------|
| Grains per gallon | 27'000 |
| Chlorine | 1'250 |
| | Parts per Million. |
| Free ammonia | 0'010 |
| Albumenoid ammonia | 0'100 |
| | Grains per Gallon. |
| 212° F.—Total solids | 27 |
| Ignited | 15 |
| Loss | 12 |

No trace of lead, copper, or iron.

(Clark's Scale.)

| | |
|----------------------------|------|
| Temporary hardness | 22'0 |
| Permanent ,, | 9'0 |

This water contains organic matter in such quantity as to render it unfit for domestic use. The contamination is not of very recent date; it is free from harmful metallic impurities; it is hard, but becomes soft by boiling. Until the source of pollution is removed, none of this water should be used without previous filtration.

D.

Analysis of water from well:—

| | Grains per Gallon. |
|--|--------------------|
| Total solid residue | 24'1500 |
| Chlorine | 0'9100 |
| Ammonia | 0'0007 |
| Nitrogen in the form of nitrites } and nitrates | 0'5870 |
| Temporary hardness | 12'8000 |
| Permanent ,, | 5'8000 |
| Total ,, | 18'6000 |

The amount of chlorine present is equivalent to 1'49 grs. per gallon of water. The water has no taste or odour, and contains no iron or lead. The hardness shows that there are present lime and magnesia salts, extent equivalent to 18'6 grains of carbonate of lime per gallon; of these, 12'8 grains per gallon exist as carbonates and are precipitated on boiling, leaving 5'8 grains of lime and magnesia salts other than carbonates (sulphates, nitrates, &c.) per gallon in solution.

The amount of oxidised nitrogen in the form of nitrates in the water is somewhat higher, but all the other indica-

tions of the analysis are those of a perfectly pure water. I should, therefore, consider this water quite fit for all domestic purposes.

Chemist D also sent the following note:—

"Dear Sir,—In answer to your enquiry by letter just to hand, I beg to state that I consider that (as far as chemical analysis can determine) the water from the well is fit to drink, and that it is not necessary either to boil or filter it previously to use."

E.

Analysis of water from the well:—

| | Grains in Gallon. |
|------------------------------------|-------------------|
| Chloride of sodium | 1'847 |
| Chloride of calcium | 0'025 |
| Sulphate of lime.. .. . | 4'360 |
| Nitrate of lime | 1'852 |
| Carbonate of lime | 16'948 |
| Carbonate of magnesia | 0'883 |
| Oxides of iron and alumina | 0'070 |
| Silica | 0'700 |
| Permanent hardness | 4'4 |
| Temporary ,, | 17'9 |
| Total ,, | 22'3 |
| Free ammonia | 0'000421 |
| Albumenoid ammonia | 0'000791 |

It will be seen, from the above results, that this water contains considerable quantities of both carbonates and sulphates of lime, which renders it harder than is desirable for washing and cooking purposes. Of the hardness, three-fourths, however, may be removed by boiling.

The quantities of free and albumenoid ammonia contained in this water are exceedingly small, and in this respect the water may be pronounced to be very pure. On the whole, it may be said that this water is rather too hard for cooking and washing, but it may be used with safety for drinking, although it is advisable, on account of its hardness, that it should be previously boiled.

The following note was sent with the analysis (E. analysed two samples):—

"Dear Sir,—Herewith I forward you my reports on the two waters. I am very glad that the results are so favourable; the waters are, indeed, unusually pure, but somewhat too hard.—I remain, &c."

This tabular statement will clearly show where they differ:—

| | Solids. | Total Hardness. | Permanent Hardness. | Temporary Hardness. | Nitrates. | CaSO ₄ . | Cl. | CaCO ₃ . | SiO ₂ . |
|----|---------|-----------------|---------------------|---------------------|-----------|---------------------|------|---------------------|--------------------|
| A. | 27'5 | 23'0 | 7'0 | 16'0 | 2'500 | 6'5 | 0'78 | 15'8 | 0'6 |
| B. | 22'8 | — | — | — | 3'500 | 0'5 | 0'78 | 17'0 | 0'7 |
| C. | 27'0 | 31'0 | 9'0 | 22'0 | 0'587 | — | 1'25 | — | — |
| D. | 24'1 | 18'6 | 5'8 | 12'8 | — | — | 0'91 | 18'6 | — |
| E. | 26'6 | 22'3 | 4'4 | 17'9 | 1'852 | 4'3 | 1'27 | 16'9 | — |

A.'s verdict is—That the water is of good quality.

B.'s ,, —It is surface-water, and is bad.

C.'s ,, —So much organic matter as to be unfit for drinking.

D.'s ,, —A perfectly pure water, and quite fit for all domestic purposes.

E.'s ,, —The water is unusually pure.

After such verdicts, surely it is necessary we should have some reforms in our practice of analytical chemistry.—I am, &c.,

J. CARTER BELL.

20, East Corridor,
59, Mark Lane, London, E.C.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—Having observed in the CHEMICAL NEWS (vol. xxxii., p. 238) a letter signed "Black-Ash," where the correspondent seems surprised at the low percentage of sodium sulphate in the samples of black-ash A and B, given by

Mr. George E. Davis in his elaborate paper on the "Manufacture of White Caustic Soda" (see CHEMICAL NEWS, vol. xxxii., p. 176), I beg to mention the fact that I have frequently known the average of a whole shift's work from ten hand furnaces to be under 0.2 per cent of real sodium sulphate undecomposed, and that made by the use of sluted lime only, although the general work extending over several months would be on an average of about 1.2 per cent.

I noticed that the undecomposed sodium sulphate in the black-ash samples A and B referred to were low, and that there was a greater proportion of sulphate in the vat-liquors than in the black-ash itself, and hence an apparent discrepancy. But Mr. Davis does not tell us that the vat-liquors were the production of the particular black-ash in question, and as one who has had practical experience of the subject I would not suppose that such was the case. Perhaps Mr. Davis will enlighten us on the subject. I also noticed a great similarity in the proportion of sulphate to alkali in the vat-liquor before dilution, and before and after causticising, which proportion I should think to be about the general average, but which may be if anything a trifle higher.

Chemists I am sure will agree with me when I say that very great praise is due to Mr. Davis for placing in such a clear and complete form the whole subject of white caustic soda working. His paper forms the most valuable treatise which has ever appeared on the subject.—I am, &c.,

G. A. R.

November 13, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—By the letter of "Black-Ash" I am glad to find some one taking a deep interest in the analyses of the products in the manufacture of white caustic soda.

For the information of "Black-Ash" (CHEM. NEWS, vol. xxxii., p. 238), and others who may be disposed to ask similar questions, I may state once for all that the products, the analyses of which are given in my paper, are not necessarily the outcome of a previous process. For instance, the black-ash was not made from the identical salt-cakes of which I give the analyses, neither was the vat-liquor made from the black-ash balls A, B, C.

If there is any special connection between two or more sets of products it is specially stated in my paper. I could not do more than this: I have stated that A and B were good balls, and C a bad or burnt one; and although C is given as an example of a bad ball, it is not because there happens to be 3.037 per cent, but because there is also associated with it 6.645 per cent of sodium sulphide.

The average sulphate generally left undecomposed in hand-furnace balls is about 1.5 per cent on the weight of the black-ash taken for analysis. Several paragraphs before the analyses of A, B, and C there will be found two estimations of the sulphate taken from balls on the ball-bank; there the sulphate is 1.2 per cent and 1.7 per cent, and it is there stated that "each experiment is the average of seventy-two balls."—I am, &c.,

GEORGE E. DAVIS.

St. Helens, Lancashire,
November 15, 1875.

SUGAR ANALYSIS.

To the Editor of the Chemical News.

SIR,—Allow me space in your valuable journal for the following lines:—Would any of your readers be kind enough to inform me about an exhaustive work on sugar manufacture from cane, wherein special attention is given to laboratory manipulations, especially the analysis of raw sugar. At the same time I should be much pleased to be informed of such works in the French language.—I am, &c.,

P. H.

Shepton Mallet, November 9, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As one or two of the letters on this subject have, I fear, tended to create an impression amongst consumers that sulphate of ammonia cannot, with any certainty, be bought free from "sulphocyanide," allow me to state that one of the largest producers of the article (the party referred to in my letter of October 15th) has, since the discussion commenced in your columns, inserted in all his sale notes the following words:—"Guaranteed free from sulphocyanide."

If buyers, who have hitherto strained at the gnat of "colour" and swallowed the camel of sulphocyanide, would now in all cases include these words in their offers, they would have the remedy for the evil in their own hands. I may add for their information that the test for sulphocyanide is so simple that anybody, chemist or non-chemist, may perform it for himself:—A drop or two of perchloride of iron added to a portion of the dissolved sulphate will at once turn it red if sulphocyanide be present.—I am, &c.,

ONWARD.

November 17, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

SIR,—I am not quite sure that I understand Mr. Readwin's query in the CHEMICAL NEWS (vol. xxxii., p. 225), *i.e.*, whether he requires information as to complete and perfect crystals occurring in the forms mentioned, or only as to *observed planes* of those forms.

If the former be the proper interpretation of his query I fear I can give him very little information, since simple and perfect anorthic crystals do not often come under my notice; but one may very often see good planes of the *doubly-oblique rhombic* and *doubly-oblique rectangular* prisms in both natural and artificial crystals of blue vitriol. Mitchell (Orr's "Circle of the Sciences") states that Babingtonite, Christianite, and Sassoline (as well as blue vitriol) exhibit planes of the "doubly-oblique rectangular prism;" blue vitriol, Christianite, and Sassoline of the "doubly-oblique rhombic prism;" Christianite and Sassoline of the "doubly-oblique rhombic pyramid" (and "spheroid"); blue vitriol, Sassoline, Christianite, and Babingtonite of the "doubly-oblique rectangular pyramid" (and "spheroid"). The new crystals of chalkosiderite from Cornwall, described by Professor Maskelyne, exhibit planes parallel to the "doubly-oblique rhombic prisms," the "doubly-oblique rectangular prisms," and the "doubly-oblique rectangular pyramid."—I am, &c.,

J. H. COLLINS.

Truro, November 10, 1875.

CHEMICAL NOMENCLATURE.

To the Editor of the Chemical News.

SIR,—In the opening address of the President of the Chemical Section of the British Association, at its late meeting, regret was expressed at the small number of chemical students in this country as compared with Germany and other Continental nations. May not this arise from the appalling system of nomenclature given to organic substances? A would-be student takes up a work on organic chemistry, and meeting with such words as selen-eyan-ethylen and paramido-ortho-sulpho-toluic acid (I select at random from the CHEMICAL NEWS) is deterred from proceeding further in the study of a science in which such crack-jaw names are to be found. Could not a more simple system of nomenclature be found? Another drawback appears to me to be the absence of any modern work on the classification of organic substances—I mean a work something on the plan of Dr. Gregory's "Outlines of Chemistry," published some thirty years ago. I beg to submit these two suggestions to the consideration of those

who are better able to pronounce judgment on the subject than myself.—I am, &c.,

AN AMATEUR.

November 15, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 17, October 26, 1875.

New Spectro-Electric Tube (Modification of the Fulgurator).—MM. B. Delachanal and A. Mermet.—This tube is said to possess the following advantages:—Fixity of the spark, permitting a prolonged observation of the spectra; suppression of the meniscus, and consequently of the absorptions which it produces, and which partially hide the spark; removal of the electrodes into a special tube, which preserves the instrument from corrosive projections; possibility of collecting the total of the substance examined; possibility of forming a collection of spectroscopic tubes, containing permanently the solutions of various substances, and allowing of rapid demonstrations and comparisons. The description of the instrument would be unintelligible without the accompanying illustration.

Laws which Govern Reactions of Direct Addition.—M. Markovnikoff.—In this note the author gives further illustrations which fall under the first part of the law as stated in his last paper.

The Nitrate of Soda Trade of South America.—M. V. L'Olivier.—The nitre beds were discovered in 1821 by Mariano de Rivero, but were not worked till ten years later. The nitre forms irregular masses, alternating with beds of common salt and borate of lime, at the height of about 1000 metres, and extending from 19° to 23½° south latitude. The formation is probably due to the evaporation of salt lakes. The thickness of the nitre varies from 0.3 to 2 metres. It is generally covered by a harder saline deposit, known as the *costra*, containing a much lower percentage of nitrate of soda. The composition of a sample of nitre from the basin of the Loa was—

| | |
|----------------------------------|------------------|
| Nitrate of soda | 51.50 |
| Sulphate of soda | 8.99 |
| Chloride of sodium | 22.08 |
| Chloride of potassium | 8.55 |
| Chloride of magnesium | 0.43 |
| Carbonate of lime | 0.12 |
| Silica and oxide of iron | 0.90 |
| Iodide of sodium | sometimes traces |
| Insoluble matter | 6.00 |

A sample of the "Costra" contained—

| | |
|----------------------------------|-------|
| Nitrate of soda | 18.60 |
| Sulphate of soda | 16.64 |
| Chloride of sodium | 33.80 |
| Chloride of potassium | 2.44 |
| Chloride of magnesium | 1.62 |
| Carbonate of lime | 0.09 |
| Silica and oxide of iron | 3.00 |
| Insoluble matter | 20.10 |

Some samples of nitre contain, however, 60 to 70 per cent of nitrate of soda, and it is even sometimes found pure and crystalline. The export duties which the Peruvian Government has laid upon nitrate of soda—to prevent it competing with guano—will soon restrict the trade to the valley of the Loa, in Bolivia.

Experiments made on Geissler Tubes with the Nitrate of Silver Battery already described.—MM. Warren de la Rue and H. V. Müller.—The authors

describe four photographic proofs illustrating their experimental results.

Spiral Nebulæ.—M. G. Planté.—The author remarks that if spectrum analysis has latterly enabled us to study the chemical composition of the heavenly bodies, it is not rash to seek to give account of their physical constitution by the observation of electric phenomena. He points out the close resemblance of the spiral nebulæ, as described by Lord Rosse with the result of an experiment in which a cloud of metallic matter, torn away from an electrode by the electric current, takes in the midst of a liquid a gyratory spiral movement under the influence of a magnet.

Moniteur Scientifique, du Dr. Quesneville,
November, 1875.

Ferments and Fermentations.—M. Ch. Blondeau.—From this lengthy treatise we extract the following passages:—During the flowering of certain plants we observe an elevation of temperature, accompanied by a disengagement of carbonic acid, which has led certain authors to say that at this part of their existence plants respire in the same manner as animals. In fact, at this period the sugar stored up in the plants undergoes the alcoholic fermentation, and the alcohol formed is burnt, and in burning produces the heat needful for reproduction. When a fruit—*e.g.*, an apple or a pear—has reached maturity, and after being detached from the tree is placed in a vessel of lime-water, the turbidity which appears in the water proves that a development of carbonic acid is taking place. If the fruit, which has thus lived for some time in the absence of air, is submitted to distillation, a notable quantity of alcohol may be obtained, as shown by MM. Lechartier and Bellamy in their researches on the ripening of fruits. Even the simplest vegetables—algæ, lichens, and fungi—contain, during all the course of their existence, alcohol pre-formed, the combustion of which serves to maintain the heat needful for their existence.

Refutation of the Prejudices of Certain Demi-Chemists concerning Salicylic Acid.—M. H. Kolbe.

Antiseptic Effects of Salicylic and Benzoic Acids in the Fermentation of Beer and in Urine.—E. von Meyer and Kolbe.

Use of Salicylic Acid for the Preservation of Milk.—M. A. Pourian.—The nature of these three papers can be sufficiently understood from their titles.

Use of Salicylic Acid in Titration.—Dr. H. Weiske.—In determining nitrogen by the method of Varrentrapp and Will, the author uses salicylic acid instead of litmus in the final titration. He dissolves any quantity of salicylic acid in distilled water, separates by filtration any insoluble residue which may remain, and adds to the clear liquid a few drops of a solution of perchloride of iron. Then by means of a burette he pours into the deeply coloured solution a few drops of a very dilute soda-lye till it is exactly neutral, when it takes a yellowish red colour. He then adds to the acid to be titrated a few c.c. of this liquid, which does not take any colour at the commencement, but in proportion as the titration with standard soda is carried on, and the liquid approaches neutrality, a violet colour becomes more manifest. At the moment when neutralisation is on the point of being reached the colour presents its greatest intensity, then as soon as the slightest excess of soda is added it disappears suddenly.—*Journal für Praktische Chemie*.

Chemical Nature of Salicylic Acid.—H. Kolbe.—Salicylic acid is merely benzoic acid contaminated with a very small amount of a foreign body not yet determined.

Complete Separation of Arsenic from Animal Matters, and on its Determination in Various Tissues.—M. Armand Gautier.—Already noticed in the *Comptes Rendus*.

Preparation of Tungsten: Composition and Analysis of Wolfram.—M. Ferdinand Jean.—The analysis of wolfram presents some difficulties: the attack

of the ore by *aqua regia* is very slow, often incomplete, and the tungstic acid separated is impure. If the ore is fused with alkaline carbonates it is almost impossible to obtain an integral disaggregation, and the ultimate separation of the tungstic acid, the alkalies, and the silica can only be effected accurately by precipitating the tungstic acid with proto-nitrate of mercury, which very much complicates the analysis. The operation may be effected exactly by mixing intimately 1 gram. of the wolfram to be examined with 0.5 gram. of pure carbonate of lime, and 0.5 gram. of fused chloride of sodium, and igniting the whole for half an hour in a platinum boat, kept in an atmosphere of pure dry nitrogen. After ignition the mixture is treated in heat with hydrochloric acid, which separates out tungstic acid in an insoluble state, and dissolves the oxides of iron and of manganese, lime, &c. It is diluted with water and filtered. In one part of the filtered liquid peroxide of iron is titrated with protochlorides of copper and tin (*Moniteur Scientifique*, June, 1875); then in the rest of the liquid, which is oxidised with chlorates of potash, the whole of the iron is thrown down as hydrated peroxide by boiling with acetate of soda. The solution, freed from the iron, is mixed with sulphide of ammonium, and deposits the manganese as sulphide, which is converted by the action of nitric acid and by ignition into red oxide, and weighed as such. By evaporating the filtrates—in which, if needful, the lime and magnesia may be determined—we separate out a part of the silica which has been dissolved since the attack by hydrochloric acid, and collect in on a filter. With ores containing silica the tungstic acid obtained must not be weighed directly, since it always retains a little silica. It is necessary, in this case, to wash the tungstic acid upon a filter with water containing its own volume of ammonia at 22° until all is dissolved. If the ammoniacal solution of tungstate of ammonia is set aside for five to six hours the silica is completely deposited. It is collected upon the filter already containing the silica obtained by the evaporation of the acid liquors, and the whole is ignited. The solution of tungstate of ammonia, freed from silica, is then evaporated to dryness, and the residue of the evaporation is treated with nitric acid, and then ignited, when pure tungstic acid remains, and may be weighed. In those operations where the object is merely to find the percentage of tungstic acid in the wolfram, the sample may be ignited with soda-lime in contact with the air, for the decomposition in an atmosphere of nitrogen serves merely to enable the amount of ferric oxide to be determined.

Central-Blatt für Agrikultur Chemie,
Heft 9, September, 1875.

Chemical Composition of the Löss Formation.—
Dr. A. Hiller and L. Mutschler.—

| | Soluble in Hydrochloric Acid | Insoluble in Hydrochloric Acid |
|-------------------------------|------------------------------------|--------------------------------------|
| | 31.218. | 68.182. |
| Lime | 6.263 | 0.8750 |
| Magnesia | 1.549 | 0.1120 |
| Carbonic acid | 6.020 | — |
| Potash | 0.441 | 1.4390 |
| Soda | 0.327 | 0.9380 |
| Lithion | — | 0.0074 |
| Chlorine | 0.032 | — |
| Ferric oxide | 3.723 | 1.5490 |
| Alumina | 2.915 | 9.1580 |
| Silica | 6.852 | 55.2860 |
| Phosphoric acid (hydrated) .. | 0.978 | — |
| Water | 2.649 | — |

30.849 69.3644

The agricultural value of the Löss soils is very high.

Experiments on the Application of Chemical Manures in the Cultivation of Potatoes and Corn.—Eugen Risler.—Taken from the *Journal d'Agriculture Pratique*, 1875, vol. i., No. 10, p. 311.

Knowledge of Milk.—Al. Schmidt.—If milk is freed from diffusible matters (sugar, salts, &c.) casein is separated in the dialyser, along with a trace of phosphate of lime, as a fine precipitate, which re-dissolves neither in soda-lye and acetic acid, nor in the concentrated diffusate of the milk, and has therefore undergone a change.

Results of Food for Sheep.—O. von Reden-Franzburg.

Temperature which Plants Assume in Sunshine.—Dr. E. Askenasy.—On July 15, 3 p.m., the thermometer indicated 31° in the shade:—

| | | |
|----------------------------------|-------|------------------|
| <i>Sempervivum alpinum</i> | 49.3° | internal, 49.0°. |
| „ <i>arenarium</i> | 48.0° | „ 48.7°. |
| „ <i>soboliferum</i> | 43.7° | „ |

Another *Sempervivum*—

51.2 .. internally, 48.7°.

Obretias and *gentianas* indicated a much lower temperature.

Chemico-Physiological Researches on the Nutrition of Plants.—Prof. W. Knop and Dr. Hugo Dworzak.—An interesting paper, but not suitable for abstraction.

Investigations on the Sap Issuing in Spring from Recently Pruned Vines, and on the so-called Bleeding of the Vine.—Prof. C. Neubauer and Dr. von Canstein.

MISCELLANEOUS.

University of London.—(*Second B.Sc. Examination*, 1875).—*Pass List*. First Division. S. H. Carrington, Owens College; J. E. Clark, B.A., private study; G. Gates, B.A., private study; F. Gotch, B.A., University College; J. E. Harris, B.A., private study; J. V. Jones, University College; J. M. H. Munro, Royal College of Science, Dublin; C. M. Thompson, University College; S. P. Thompson, B.A., Royal School of Mines. Second Division. J. W. Buck, private study; R. Capron, B.A., private study; F. A. Cooper, Owens and University Colleges; F. J. Gladman, B.A., private study; T. F. Harris, private study; O. J. Lodge, University College; W. Saise, Royal School of Mines; A. J. Smith, Owens College; G. Smith, Royal School of Mines; T. S. Tait, St. John's College, Cambridge; H. D. Waugh, B.A., University College.

Dyeing and Calico Printing.—Messrs. Palmer and Howe, of this city, have in preparation a work of considerable importance to manufacturers. It is a treatise on "Dyeing and Calico Printing," by the late Dr. F. Crace-Calvert, F.R.S., F.C.S. It will include a short account of the most recent improvements in the manufacture and use of aniline colours, and is being prepared under the editorial care of John Stenhouse, LL.D., F.R.S., and Charles Edward Groves, F.C.S. The publishers have already disposed of an edition for the American market.—*Manchester Guardian*.

The Iron and Steel Institute—Supplementary Meeting.—In consequence of the time at the Manchester Meeting being insufficient to allow of the reading and discussion of several papers that were upon the programme, it has been decided to hold a Supplementary General Meeting in London, on Thursday, November 25. By the kind permission of the Council of the Institution of Civil Engineers, this meeting will be held in the rooms of that Society, 25, Great George Street, Westminster, London, S.W., at 10.30 a.m. The following is the programme:—Adjourned discussion on Mr. Adamson's paper on "High Pressure Steam Generally, and its Application to Quadruple Engines;" discussion on Mr. I. Lowthian Bell's paper on "Price's Patent Retort Furnace;" paper by Mr. G. J. Snelus on "Fire-clay and other Refractory Materials;" paper by Mr. William Hackney on the "Manufacture of Anthracite Coke in South Wales;" paper by Mr. C. J. Homer on the "North Staffordshire Coal-field, with the Ironstones contained therein."

THE CHEMICAL NEWS.

VOL. XXXII. No. 835.

CHEMISTRY IN SWANSEA.

WE have repeatedly insisted on the necessity of a thorough organisation for analytical chemists, both for the sake of raising and securing the *status* of the profession, and of excluding all improper and unqualified persons. Indeed, these two objects are practically identical. So long as any person, competent or otherwise, can call himself an "analytical and consulting chemist," and can practise as such, so long the *bonâ fide* members of the profession will be deprived both of the consideration and the emoluments to which they are justly entitled. An event—we might say a scandal—which has happened at Swansea gives the fullest confirmation to our remarks. We have hitherto refrained from commenting upon this case in the hope that the gentleman whose professional character is at stake would have been able to offer some explanation of the circumstances. Indeed, so extraordinary are the details, that save for the fact that the Principality is not prone to jesting, we should have received the whole affair as a hoax. As, however, neither contradiction nor explanation appears we are compelled to accept the case as real, and to deal with it as such.

At the Glamorganshire Quarter Sessions a man was charged with stealing a gallon of oil. The point turning on the identity of the oil found in his possession with that supposed to have been stolen, the prosecution called "W. Morgan, Ph.D., F.C.S., analytical chemist and public analyst for the Borough of Swansea," who "produced certain samples of oil, which, he said, were all a mixture of rape-seed oil and a little train oil, only differing in degree as to proportion. There was a little Gallipoli oil in one of the samples. The Chairman: What is train oil? Witness: I don't know. Chairman: Is it a vegetable oil or a mineral oil? Witness: A vegetable oil. Chairman: In what proportion does the train oil exist in the four samples? Witness: I don't know. Chairman: What are the constituent parts of train oil? Witness: I don't know. Chairman: Cannot you tell in what proportion the train oil exists in the samples you have produced? Witness: No, I cannot. No living man can tell. (Taking a book from his pocket, and looking into it.) I wish to correct myself. I find here that train oil is taken from the whale. Chairman: Then it is not a vegetable oil? Witness: No, a mineral. The witness was closely cross-questioned by Mr. Dunn, and stated that he knew all along that train oil was a mineral oil, but he got confused. He did not know that the Esquimaux were fond of train oil, but he knew that the component parts of the oil were carbon, hydrogen, and oxygen."

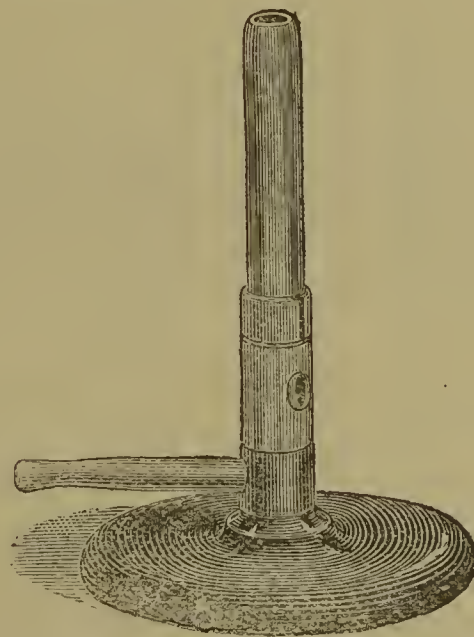
We are utterly at a loss to comprehend this extraordinary evidence. Leaving out of the question all chemists, analytical or pharmaceutical, all drysalter, oilmen, and the like, we should have believed that every schoolboy knew that train oil is the product of the whale, and that whales are not "minerals." The fact of a member of a learned profession, a University graduate, and Fellow of a scientific society having to consult a book to ascertain the nature of so common a substance is so humiliating that all comment is an anti-climax. But the bearings of the matter cannot be thus briefly dismissed, and must be viewed by all friends of science with painful concern. The "Adulterators' Organ" is evidently in high glee, which will doubtless be shared by those unscientific Members of Parliament who have kindly taken upon themselves to adjudicate on the "competence" of chemists, and whose absurd charges will receive from this incident at least a colour of truth. But from the bodies who are, more or less, gravely compromised by Mr. Morgan's self-

exposure, we must expect not merely thought, but action. The gentleman in question must be assumed, until we have proof to the contrary, to be a graduate of some German university. Now such ignorance as he has displayed might have been conceivable in an Oxonian of the old school, who complacently overlooked all knowledge not contained in the classics. But the normal German "Gelehrte" is no less distinguished for the wide compass than the minute accuracy of his learning, and for Berlin or Giessen, Göttingen or Bonn, Heidelberg or Leipzig to have turned out such a graduate is exceptional almost beyond belief. Whatever university has the honour of being his *Alma Mater* would do well to exercise for the future a judicious caution in granting degrees. Not less must the Chemical Society look to the matter, and consider whether its Fellowship is not sometimes bestowed too lightly. If such scandals as this recur the letters F.C.S. may not be highly coveted by men conscious of their own standing. In former days men were judged by their degrees and diplomas. Now they must be estimated rather by their researches and writings. Dare we add that perhaps degrees and diplomas may come, before long, to be judged according to the personal merit of their holders?

A NON-RETREATING BUNSEN BURNER.

By President HENRY MORTON, Ph.D.
Stevens Institute of Technology, Hoboken, N.J.

IN consequence of the low pressure of gas during the day-time, in this place, we have long experienced trouble from the retreating Bunsen burners of the usual construction. This having repeatedly proved a source of annoyance and loss, I was led to a series of experiments with the view of removing the difficulty, if possible, by some modification in the form of the burner.



After various trials with burners, in which the relation of height to diameter in the main tube and of the size of the gas-jet were varied, I was led to the following consideration of the subject:—

The retreat of a burner will evidently occur whenever any part of the ascending column of mixed gas and air is moving at the orifice with a velocity less than that at which the same will burn downwards. Now, in an ordinary burner, with its main tube of regular cylindrical bore, it is evident that the friction of the surface of the ascending column of mixed gases will cause that portion to move at a less velocity than the central part, and that currents of the nature of eddies will be developed.

It will thus happen that while the central portion of the ascending column of gaseous mixture issues at a velocity much greater than that at which the material can burn downwards, and thus is quite free from any danger of retreating, the marginal portions of the column or jet of gas will be escaping at a rate so much less that the velocity of their combustion downwards will exceed that of their upward motion, and retreat of the flame will ensue.

It is well known that to secure a jet of water, or of any other fluid whose particles shall move with equal velocities in all parts, and thus avoid currents and eddies, it is only necessary to make the orifice of efflux an aperture in a thin wall.

Following out the idea above indicated, I made a burner of a bore rather large compared with its height, and then drew in its upper edge into the form of an open-ended thimble, so contracting the orifice of escape to about two-thirds the area of the tube, and rendering this orifice practically an opening in a thin horizontal wall or plate.

The results of this modification far surpassed my anticipations. A burner thus constructed gives a perfectly non-luminous flame with gas pressures varying between 1.5 and 0.1 inch of water, and with the lowest of these pressures cannot be made to retreat by the most violent handling in the way of sudden movement or waving about in the air, even when this violence is carried to the extent of extinguishing the flame altogether.

Under like conditions of pressure, a burner of the ordinary construction is made to retreat by a slight draught of air, or a very moderate amount of motion.

These burners have been constructed in quantities for our use and for other colleges by Messrs. Geo. Wale and Co. of this place.

A DERIVATIVE OF THE HYDROCARBON, VALERYLENE.

By P. HAUBST, Ph.D.

As is well known, the non-saturated hydrocarbons possess the property of combining with hypochlorous acid by direct addition to form chlorinated hydric alcohols, convertible into the corresponding alcohols by appropriate chemical reactions.

In order to show this in the case of the hydrocarbon valerylene, first obtained by Reboul, I prepared a sufficient quantity of this substance from amylene, obtained by heating zincic chloride with amylic alcohol (fusel oil), and caused it to be acted upon by hypochlorous acid. The compound thus formed was extracted by ether, and, the latter being distilled, a brown-red liquid remained.

Expt. 1.—10 grms. valerylen yielded 15.0 grms. product.
Expt. 2.—10 „ „ „ 15.2 „ „

A sample of the new product was submitted to distillation. At 90° C., the liquid assumed an intensely dark colour; the temperature being increased, a liquid of an highly irritating odour distilled over, while at the same time hydrochloric vapours were evolved. At 140° C., a total decomposition took place, and a black syrupy mass was left in the residue.

To ascertain the atomical composition, a sufficient quantity of the original product was dried and submitted to elementary analysis.

The chlorine was determined according to the method devised by Professor Carius, in sealed glass tubes at a high temperature.

Expt. 1.—0.1610 gm. yielded 0.0463 gm. Cl, or 28.72 p. ct.
Expt. 2.—0.1718 „ „ 0.0488 „ „ 28.28 „

Carbon and hydrogen were determined by means of combustion with plumbic chromate, with the following results:—

Expt. 1.—39.23 per cent carbon, 5.94 per cent hydrogen.
Expt. 2.—39.38 „ „ 5.82 „ „
Expt. 3.—38.91 „ „ 6.04 „ „

If we take the average of these numbers, and calculate, as usual, the oxygen from the loss, the following results are obtained:—

C = 39.24
H = 5.93
Cl = 28.53
O = 26.30

If we divide by the corresponding atomic weights and take the chlorine as unit, we have the formula $C_4H_7ClO_2$.

The different behaviour of valerylene to hypochlorous acid must be accounted for by its different molecular structure. As it was mentioned, the valerylene used in our researches was prepared from an isoamylene; the latter kind of hydrocarbons generally split up when acted upon by energetic reagents.

That new body, empirically of the same composition as monochlor-butyric acid, has a sp. gr. of 1.065 at 15° C., is of a strongly acid character, and reduces silver salts to metallic silver. It has a highly penetrating odour, and burns with a green-edged flame.

On adding water and ammonia, a clear solution is obtained; argentic nitrate does not precipitate the chlorine, but, after evaporating to dryness and re-dissolving, chlorine is eliminated. The salts obtained with baric, calcic, and plumbic carbonates or hydrates bear the same character. Thus, it seems, this body has not the property of forming distinctly characterised salts.

Shepton Mallet, November 16, 1875.

INCRUSTATION ON AN OLD FLUE.

By J. W. CHALMERS HARVEY.

On opening an underground flue, 5 feet high and 3½ wide, by which the fires from a range of large boilers communicated with a high chimney, an incrustation was found on the roof and walls, covering an extent of upwards of 50 feet, and varying in thickness from ¼ of an inch to nearly 1 inch in some places, the thickest parts forming a ridge exactly over the joinings of the bricks where the mortar had been exposed to the action of the gases. In fact every joint stood out in such a way as to mark distinctly the form of each brick that had been used in lining the flue. The flue had been in constant use for about five years, and the boilers were fired with the Cumberland coal of the neighbourhood, which is a caking coal, and contains on an average about 2 per cent of sulphur. The following is an analysis of the substance dried at 212° F.:—

| | Per Cent. |
|-----------------------------|-----------|
| Insoluble matter | 23.39 |
| Ferric oxide | 2.91 |
| Alumina | 6.10 |
| Lime | 11.31 |
| Magnesia | 0.55 |
| Sulphuric anhydride | 38.14 |
| Potash | 6.47 |
| Soda | 0.52 |
| Water | 11.40 |
| | 100.79 |

It appears from the above analysis that a very considerable proportion, if not the whole, of the sulphur dioxide first formed from the sulphur in the coal has been further oxidised into sulphuric acid before it reached the chimney, and acting upon the bases of which the lining of the flue is composed converted them into sulphates. It seems also clear that the potash has been volatilised from the coal, as it is highly improbable that it owes its origin to the materials used in the construction of the flue.

In densely-populated manufacturing towns if mortar was freely used in covering the interior of flues, or lime placed in some convenient part of them, where it could be replenished from time to time, might it not be attended with beneficial sanitary results? as it would retain much of the sulphur dioxide that would otherwise escape into the atmosphere.

My thanks are due to Mr. Noble, at whose suggestion I undertook the analysis.

Chemical Laboratory of the
Maryport Hematite Iron Works,
November 12, 1875.

ALIZARIN FROM ANTHRACEN-SULPHO-ACID.

By G. AUERBACH.

II.

IN my last paper I said I believed it to be theoretically impossible to produce alizarin from anthracen-sulpho-acid, because the anthracen-sulpho-acid does not give anthraquinon by oxidising, but a sulpho-acid isomeric with anthraquinon-sulpho-acid.

The following experiment will further prove my theory that anthracen-sulpho-acid cannot produce alizarin:—

I tried to prepare anthraquinon-sulpho-acid from bichlor-anthracen-sulpho-acid. First, I converted anthracen into anthracen-sulpho-acid, and heated this body with chlorine: the temperature rose to 170° C. without heating it. The sulpho-acid was heated with an excess of chlorine, and then, to form anthraquinon-sulpho-acid, was heated with an excess of sulphuric acid at a temperature of 220° C. It forms a brown-red sulpho-acid, sulphurous acid and hydrochloric acid being given off, and a black insoluble residue, which is always obtained in the preparation of anthraquinon-sulpho-acid from bichlor-anthracen, which is not perfectly pure. The sulpho-acid salt obtained is red, like the soda salt of the common anthraquinon-disulpho-acid. By melting this with soda a violet melt is obtained, which, when precipitated by an acid, does not give any alizarin nor any trace of colour.

If the sulphuric acid had another place in the anthracen-sulpho-acid than the chlorine in the bichlor-anthracen, then the chlorine must have the place of the oxygen in the quinon. If this had been the case I ought to have obtained the common soda salt of the anthraquinon-disulpho-acid, and from this salt alizarin. But I did not get alizarin, which proves the sulphuric acid in the anthracen-disulpho-acid has the same position as the chlorine in the bichlor-anthracen. But the sulphuric acid in the anthracen-disulpho-acid is linked, and cannot be substituted by the quinone-oxygen, and, therefore, if it is substituted by hydroxyls, one obtains a body isomeric with alizarin but not identical.

Greenford Green, Harrow,
Middlesex.

ON PYROLOGY, OR ANALYSIS AND SYNTHESIS BY MEANS OF THE BLOWPIPE.

By W. A. ROSS.

(1). It is almost amusing to hear the ideas which the English people generally entertain regarding the blowpipe and its use. A considerable number have evidently never heard of such a thing at all. The immense majority conceive, or possibly know, it to be an implement used by goldsmiths, tin-smiths, and gas-fitters, but, if asked suddenly, could not say whether it might not be useful to some other people as well. Even among the select few who appreciate the utility of this instrument in England, that is circumscribed (as will be evident from the perusal of any of our works on chemistry or mineralogy) to a means of identification or confirmation, rather than of analysis.

(2). Now the fact certainly is—although I am not prepared to say that any of us yet understand the art sufficiently to prove it in all details—that, when this science and its results are collated with the careful use of the microscope and the assay balance, a method of analysis has been attained which yields to no human one, not even that by the spectroscope, in minuteness combined with exactness.

(3). It is true that the best operator with the blowpipe can by no means, as yet, perform anything like an analogous process to the beautiful, and, it may be presumed, nearly perfect, system of *separation* of substances obtained in watered solution, by the aid of the violent acids and

alkalies, which constitutes the noble science called modern analytical chemistry; but, on the other hand, it will be evident to the warmest, if yet candid, chemist, that the most delicate of his analytical methods must give place to those obtainable by means of the blowpipe, if used with due intelligence. And it must be remembered that the former science, inaugurated (as to its due importance) by Scheele, Klaproth, Berzelius, Davy, and brought to such perfection by the present generation of analysts, dates, in reality, from about the time of Paracelsus;* while that of blowpipe analysis, degraded into a confirmatory testing process by the chemist, and into a “fusible or infusible” testing process by the mineralogist, can be scarcely said to have properly commenced; so that we cannot doubt that a similar application to it of such minds as those belonging to the names above mentioned would develop a system of pyrological *separation* equal in delicacy and importance to that of chemical analysis.

(4). Admitting, then, as we must, that analysis and synthesis, by means of the blowpipe, is susceptible of being systematised as a science standing on its own ground, without more, or even as much, assistance from hydracid, or ordinary chemistry, as this requires from that, we find, at starting in such a labour, that the student possesses the enormous advantage of not being perplexed with, and confounded by, the tremendous terminology—the dinitroxanthracenes or tetra-methyl-anthracenes, &c.—which the study of chemistry nowadays entails. Fortunately, also, no one has yet suggested the application of the doctrines of equivalence and atomicity to the work of the blowpipe, which may, therefore, be looked upon as an essentially *practical* and thoroughly *simple* science, which, notwithstanding its evident importance, is, therefore, far from being without the grasp of an ordinarily intelligent comprehension.

(5). Analysis by means of the blowpipe is supposed to be confined to inorganic substances; but, although that of organic matters has certainly, as yet, been scarcely attempted, and only, I believe, by myself, that it is not merely possible, but likely to be really important, will readily be admitted by any operator who, possessing a good microscope, places in the focus of that a *boric acid* bead or glass in which an ordinary healthy house fly has been burned, and alongside of it another bead of the same substance, in which a fly poisoned by an arsenical fly-paper has been consumed. The difference is *so striking* that no physician, worthy of the name, would fail to observe it. Not a scrap the size of a pin's head of our skin, nails, hair, blood, mucus, &c., but shows, when similarly analysed, really considerable traces of inorganic matter, as calcic phosphate, and silica, so that the conclusion almost seems that, although (as chemists relate) the proportion of the latter is infinitesimally small, it is so dispersed in every minute part of the former that this may be almost said to be built up of that. When we consider, then, that scarcely a single one of the innumerable organic substances found in nature, or separated by the chemist, has been thus examined, we at once see what a vast and novel field of this mode of research is open to any physiologist who likes to take it up.

(6). But, as we must be able to walk before we can venture to run, I propose in these pages to give as simple, and yet as little incorrect, account as I can of that invaluable little instrument, the *blowpipe*, of the few reagents required, and of the method of using both; so that it shall not be my fault if the medical, mineralogical, or geological student, the miner, the farmer, or the druggist, fails to avail himself of the important knowledge to be gained from this fascinating, elegant, cheap, rapid, accurate, and almost new method of analysis. As it will not be possible, however, to insert here *figures* of the blowpipe itself and of the few accessory implements necessary, I must refer the English student, for an idea of these, to books on the

* “Philip Aureolus Theophrastus, Paracelsus, Bombast de Hohenheim, was born in the year 1494, in the village of Hohenheim (or high snow), two miles from Zurich.”—Boerhaave

subject, such as "Berzelius," Children's or Whitney's translation (both of which I have often purchased for a shilling at the old book-stalls in London); "Blanford" and "Scheerer;" "Fuchs;" the excellent American works, as "Elderhorst," "Brush," and Cornwall's translation of Richter's "Plattner;" and my own work, "Pyrology." If any of these books are too expensive for the limited pocket of most students, it must yet be remembered that the processes they describe and implements they figure obviate the necessity of purchasing expensive, fragile, and unportable apparatus and reagents, which, to obtain anything like similar knowledge, is otherwise absolute. These expensive books, also, are (or should be) available for reference at scientific circulating libraries, or, at any rate, at the British Museum.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 242.)

At that time, the power of steering balloons was more than ever felt to be necessary. Many of Montgolfier's contemporaries, including well-known physicists and mathematicians, such as Meusnier, Monge, Lalande, &c., had pronounced this problem to be practicable. Fruitless and partially absurd attempts at its solution were not wanting. The celebrated inventor of the injector, Henry Giffard, was not deterred from carrying out new experiments in this direction in the year 1852, and the most recent attempts are based upon his ideas and those of Meusnier. Instead of the ordinary form, Giffard gave his balloon the fish-like shape of a ship, for the convenience of steering. A steam-engine, with its chimney turned downwards to obviate the risk of fire, and whose steam was simultaneously employed to maintain the draught, turned a screw sufficient to turn the balloon, but certainly too weak to overcome the strong wind which, on September 25th, drove Giffard's aerial ship before it. Public opinion then turned in favour of a project of aerial navigation opposed to all previous methods. Ponton d'Amecourt, De la Landell, and Nadar wished to attempt by mere mechanical force, without the aid of light gases, to navigate the air in all directions. The authority of Babinet supported this scheme, which, however, according to Helmholtz,† had no sound physical basis, and which, when carried into execution, proved a failure.

When the Paris Exhibition of 1867 drew general attention to every industrial advance, Giffard received a commission to make aëronautics available for the "million" by means of a hydrogen balloon. He constructed a balloon of 5000 cubic metres capacity, the inflation of which with hydrogen generated by iron and sulphuric acid in wooden casks cost 5000 francs. The gas was subsequently prepared by him for a twentieth part of the cost of conducting steam over ignited charcoal, a method of which Coutelle had made use in 1794. The balloon was attached to a wire rope 300 metres in length, and was very skilfully secured. A steam-engine of 50-horse power uncoiled the rope, and drew down the balloon with its passengers when the permitted height had been reached. This height was not great enough to occasion any danger from the expansion of the gas, hence Giffard was able to close the balloon with valves instead of leaving it open below. Thus, the loss of gas by diffusion did not exceed 15 cubic metres daily, and was easily replaced at intervals of three days.

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† Helmholtz, *Berl. Akad. Ber. u. Verhand. d. Ver. für Gewerbfl. in Preussen*, 1873, 326.

The next impulse to aëronautics was given, not by festivity, but by the terrors of war and the siege of Paris. The Académie des Sciences commissioned one of its members, Dupuy de Lôme, to make experiments on steering balloons, and the Government furnished the requisite means. Dupuy gave his balloon the fish shape,* and, in order to render its shape stable in the wind, he fitted it with an internal secondary balloon (*ballonet*), containing more or less air, and equal in bulk to one-tenth part of the main balloon. The air could be let out of this inner balloon by valves, or driven in again by means of a bellows in the car, according to a plan which Meusnier had devised as early as 1783 to supersede the use of ballast. Dupuy's balloon was further distinguished by a very firm method of suspending the car, and by the use of a varnish impermeable to gases, and made of gelatin and tannin dissolved in pyroligneous acid. The propelling screw was not turned by a steam-engine, but by eight men in the car. The balloon, containing 3450 cubic metres, was filled with hydrogen obtained from iron and sulphuric acid, and went up at Vincennes on February 1st, 1872, carrying fourteen persons. After a flight of two hours, it was let down at Noyon, a distance of 106 kilometres. By means of an anemometer, Dupuy was able to determine the independent speed of the balloon at 2.82 metres per second, whilst that of the wind was 16 to 17 metres, and the course of the balloon made an angle of 12° with the direction of the wind. The problem of steering had, therefore, been solved, though only to a very slight degree—sufficient for a calm, but insufficient for overcoming even moderate winds. The speed attained was slight. Both conditions of success depend on the employment of stronger sources of mechanical power, and this, again, requires an increase of its power of ascent, *i.e.*, of its relative levity with an enlarged volume.

(To be continued.)

THE CHEMICAL CONSTITUTION OF THE CHLORINATED METHYL & ETHYL ETHERS, AS ALSO OF THE CHLORINATED COMBINATIONS OF THESE ETHERS WITH FORMIC, ACETIC, OXALIC, AND CARBONIC ACIDS,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF
THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

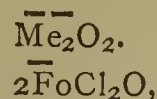
(Concluded from p. 244.)

PART II.

On the Principal Molecular Changes attending the Formation and Transformation of that Set of Chemical Compounds which fall under the Second Class of Chloro-Derivatives.

Retaining for the members of this class the familiar term "perchloro-derivatives," we shall have, in the prescribed order of succession:—

A. *The Perchloro-Methyl-Ether*, $2\overline{\text{Fo}}\text{Cl}_2, 2\overline{\text{Fo}}\text{Cl}_2\text{O}_2$.—This compound is directly descended from the perchloro-methyl-ether—

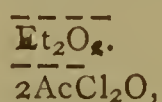


through the following series of molecular changes:—Two molecules of the ether conspire towards the production of two principal groups. The first of these groups is due to the splitting-up of the detached bases into two molecules of water and two molecules of dichloro-methylen, both of which are speedily made to merge into the isomeric modification of chloro-carbonous acid, $2\text{C}_2\text{Cl}_2$. Subsequently, one of these molecules becomes oxidised into

* Dupuy de Lôme, "Note sur l'Aéostat." Paris: Gautier-Villars. 1872.

chloro-carbonic acid at the expense of the aforesaid two molecules of water, when the chemical union of the two, now differently modified, acid bicarbon nuclei gives rise to a molecule of dichloroxalic acid, $2\text{C}_2\text{Cl}_2, 2\text{C}_2\text{Cl}_2\text{O}_2$. At the same time, the two liberated hydrogen molecules combine as adjuncts, the one with the anterior, and the other with the posterior, component member of the dichloroxalic acid, with final production of a molecule of dichloroformic acid, $2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2$. It is almost superfluous to add that, in consequence of this typical metamorphosis, the last remaining molecule of hydrogen has now likewise been rendered fit for replacement by chlorine, when the product of its last and greatest substitutional efforts will be a molecule of the perchloro-methyl-ether, as formulated above. The second of these groups is due to certain intramolecular movements in the detached acids, involving the transfer of a molecule of enveloping oxygen from one of the two conspiring molecules to the other. In virtue of this characteristic re-arrangement, the two acid bicarbon nuclei have now, with the restoration of evenness in the number of their enveloping univalent molecules, and with the accompanying excess of two molecules of oxygen in one of their envelopes, acquired different electro-polar energies, and, with these, the power of entering into chemical union with one another. The offspring of this union is a second molecule of perchloro-methyl-ether, which claims, therefore, to be regarded as anhydrous trichloro-formic acid.

B. *The Perchloro-Ethyl-Ether*, $2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2$.—This compound is directly descended from the ennea-chlorethyl-ether—



through a series of molecular changes closely analogous to those we have just been considering, the resulting products being on the side of the detached bases, the molecule $2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2$, which, by the interchange of chlorine for hydrogen, gives rise to the perchlorethyl-ether, as formulated above, and, on the side of the detached acids, a second molecule of perchlorethyl-ether, which claims, therefore, to be regarded as anhydrous penta-chloroacetic acid.

In turning to the perchloro-derivatives of the formic, acetic, oxalic, and carbonic ethers, it will not be necessary for me to enter into details, since the molecular changes attending their formation are precisely similar to those attending the formation of the two preceding perchloro-derivatives. It will, therefore, be sufficient to draw the reader's attention to the annexed tabular arrangement, where the two sets of perchlorinated ether-salts are given under the heads of their respective perchlorinated ether-bases, two molecules of which are here, for comparison's sake, represented as being condensed into one.

Table of Chemical Formulæ expressing the Chemical Constitution of the Perchlorinated Methyl- and Ethyl-Ethers, as also of the Perchlorinated Combinations of these Ethers with Formic, Acetic, Oxalic, and Carbonic Acids.

A. $(2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2), (2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2)$.

A. (1). $(2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2), (2\text{FoO}_2, 2\text{FoO}_4)$.

A. (2). $(2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2), (2\text{AcO}_2, 2\text{AcO}_4)$.

A. (3). $(2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2), (2\text{C}_2\text{O}_2, 2\text{C}_2\text{O}_4)$.

A. (4). $(2\text{FoCl}_2, 2\text{FoCl}_2\text{O}_2), (2\text{C}_2\text{O}_4)$.

B. $(2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2), (2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2)$.

B. (1). $(2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2), (2\text{FoO}_2, 2\text{FoO}_4)$.

B. (2). $(2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2), (2\text{AcO}_2, 2\text{AcO}_4)$.

B. (3). $(2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2), (2\text{C}_2\text{O}_2, 2\text{C}_2\text{O}_4)$.

B. (4). $(2\text{AcCl}_2, 2\text{AcCl}_2\text{O}_2), (2\text{C}_2\text{O}_4)$.

This table shows at a glance that all the perchloro-derivatives agree in being composed of two principal

groups, the first of which corresponds to the perchlorinated ether base, and the second to the perchlorinated organic acid. In studying the effects of temperature upon these complex systems, a curious and interesting regularity is brought to light, by means of certain marked and striking intra-molecular changes which the principal groups are mutually superinducing in, or previous to, the act of parting company with each other. This regularity may be briefly described as consisting in the uniform interchange of two molecules of chlorine contained in the envelope of the anterior member of the first principal group for two molecules of oxygen contained in the envelope of the posterior member of the second principal group, the only notable exception to this rule being the perchloro-derivatives of the methylic and ethylic carbonates, where, at least in the ordinary conditions of the experiment, the disunion of the two principal groups is not accompanied by an interchange of chlorine for oxygen.

It is in perfect harmony with our rule, as specified above, that A is observed to split up into a molecule of chloro-formyl-oxychloride (phosgen), $2\text{FoO}_2, 2\text{FoCl}_2\text{O}_2$, and a molecule of chloro-formyl-trichloride, $2\text{FoCl}_2, 2\text{FoCl}_4 \div A$ (1) into two molecules of phosgen $\div A$ (2) into a molecule of phosgen and a molecule of trichloroacetyl-oxychloride, $2\text{AcO}_2, 2\text{AcCl}_2\text{O}_2 \div A$ (3) into a molecule of phosgen and a molecule of oxalyl-oxychloride, $2\text{C}_2\text{O}_2, 2\text{C}_2\text{Cl}_2\text{O}_2$, which, in the existing conditions, is, however, speedily made to resolve itself into carbonic oxide and phosgen $\div B$ into a molecule of trichloroacetyl-oxychloride and a molecule of trichloroacetyl-trichloride, $2\text{AcCl}_2, 2\text{AcCl}_4 \div B$ (1) into a molecule of trichloroacetyl-oxychloride and a molecule of phosgen $\div B$ (2) into two molecules of trichloroacetyl-oxychloride $\div B$ (3) into a molecule of trichloroacetyl-oxychloride and a molecule of oxalyl-oxychloride, which soon resolves itself as above. Turning to the exceptional molecules, A (4) and B (4), their decomposition products by heat are found to be, for the first, carbonic acid, phosgen, and chloro-formyl-trichloride (the two latter being derived from two molecules of previously-formed perchloro-methyl-ether); and, for the second, carbonic acid, trichloroacetyl-oxychloride, and trichloroacetyl-trichloride (the two latter being derived from two molecules of previously-formed perchlorethyl-ether.)

In connection with this, theoretically, most momentous and instructive subject, I must not omit alluding to an interesting case of isomerism that obtains between the molecules A (2) and B (1). Under the influence of temperature, these compounds are both of them observed to split up into phosgen and trichloroacetyl-oxychloride, and to comport themselves towards the ordinary chemical reagents like one and the same substance. Nevertheless, the results of my analyses, as embodied in their respective formulæ, leave no doubt that these two perchloro-derivatives are not chemically identical. They are both said to possess the same specific gravity, boiling-point, and vapour density, and it would, therefore, be gratifying to learn that some skilful analyst had succeeded in discovering tangible differences in certain of their physico-chemical relations and properties.

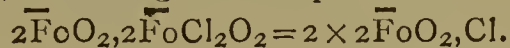
The limits of this paper will not allow of my enlarging on a theme so portentous and prolific as the molecular structure and chemical deportment of the anhydrous organic acids. In drawing to a close, I shall, therefore, confine my remarks to one or two leading features in that class of anhydrous acids which, like those mentioned in the text, are found to exhibit, in their combinations with bases, an uneven aggregate number of enveloping non-metallic elements. A careful comparison between this and the other class of acid anhydrides, which in the free state, as well as in their combinations with bases, present an even aggregate number of enveloping non-metallic elements, has revealed, amongst others, one theoretically most important point of difference between them, which is, that the members of the first class of anhydrides always

exist in the condensed form of couplets, possessing double the atomic weight exactly of what belongs to them in their chemical union with bases; whereas, in the members of the second class of anhydrides, the atomic weight remains constant simply because there is no condensation.

I shall illustrate these typical differences by means of the oxalic and carbonic anhydrides, which, by their respective formulæ, are shown to be—the former, a product of the chemical union of two molecules of oxalic acid, as it exists in its salts under the altered forms of carbonous and carbonic acid; while the latter is a molecule of unaltered carbonic acid pure and simple.

Now, with the aid of certain pregnant, but still unpublished, speculations regarding the real character of molecular substitution, as conceived in the spirit of the "typo-nucleus" theory, I hope to be able to prove that, when the oxalic anhydride splits up into its components, the metamorphoses do not consist (as a *prima facie* view might lead us to suppose) in the direct separation of the carbonous from the carbonic acid, but that it is wrought on the principle of molecular substitution, where two conspiring molecules of anhydrous oxalic acid, by the interchange of a molecule of carbonous for one of carbonic acid, give rise, on the one hand, to two chemically independent molecules of free carbonous, and, on the other hand, to two chemically independent molecules of free carbonic acid.

It is noteworthy, however, and constitutes a second leading feature in this class of molecules, that, when chlorine forms part of their envelopes, the condensed twin-acids are prone to experience yet another and different mode of dissociation from what has just been exemplified in the case of anhydrous oxalic acid. By this characteristic and equally common mode of bi-partition, which involves the transfer of one molecule of chlorine from one of the two acid components to the other, the two chemically identical and independent halves have now acquired the interesting, but variously misconstrued, faculty of interchanging that particular, and, in all probability, typically altered, molecule of chlorine for a multitude of similarly modified simple and complex organic and inorganic molecules. In illustration of this kind of metamorphosis, I may adduce the case of phosgen, which, under the influence of temperature, is made to split up into two equal halves, according to the equation—



While I am obliged to reserve the deeper consideration of this and other kindred questions for a separate communication, I may yet, in conclusion, be permitted to express an anxious hope that the broad and original views I have felt it my duty to bring to the knowledge of the chemical profession, on account of the superior insight which these views are calculated to procure into the chemical constitution of the chlorinated methyl and ethyl ethers, as also of the chlorinated combinations of these ethers with formic, acetic, oxalic, and carbonic acids—I repeat, that these confidently, but modestly, proclaimed new conceptions and doctrines—may soon have applied to them the touchstone of those judiciously planned and carefully conducted experiments, which cannot fail to suggest themselves to the minds of so many intelligent and truth-seeking explorers of nature's hidden treasures and secrets.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 18th, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced and the minutes of the preceding meeting read and confirmed, the following names were read for the first time:—

Messrs. W. Harkness, W. A. Stewart, A. Smetham, J. Davies Mucklow, H. G. Ivey, B. S. Dyer, A. E. Evans, G. Cheverton, A. Talbot, and G. H. Bailey. For the third time—Messrs. John Alfred Parry Price, B.A., Archibald Simon Lang McDonald, A. M. Graham, and William Davis, who were balloted for and duly elected.

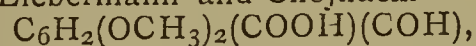
The PRESIDENT said he was happy to announce that they had almost completed the furnishing of the laboratory with apparatus for the purpose of illustrating the papers brought before the Society, and hoped it would add considerably to the interest of them. They had received a present of a balance from Mr. Longstaff, and from Dr. Frankland a Sprengel pump, with the necessary quantity of mercury.

The SECRETARY then read a paper "*On Ethyl-Phenyl-Acetylen*," by Mr. T. M. MORGAN. The sodium-derivative of phenyl-acetylen, a hydrocarbon discovered some years ago by Glaser, when treated with ethyl-iodide, yields a product from which a colourless liquid, ethyl-phenyl-acetylen, may be isolated by careful fractional distillation. It boils at 201° C, and combines with hydrobromic acid. The mono-bromide thus formed, when digested with sodium acetate and subsequently treated with potassium hydrate, gives an alcohol of the formula $\text{C}_{10}\text{H}_{12}\text{O}$, and boiling at about 225° C.

The PRESIDENT having thanked the author,

Dr. C. R. A. WRIGHT read a communication "*On Narcotine, Cotarnine, and Hydro-Cotarnine*," by himself and Mr. G. H. BECKETT. The action of water on narcotine hydrochloride is similar to that on the narceine salt, splitting it up into hydrochloric acid and basic salts. The action of ethyl-iodide on hydro-cotarnine produces a compound of the formula $\text{C}_{12}\text{H}_{15}\text{NO}_3, \text{C}_2\text{H}_5\text{I}$, and this, when decomposed by silver hydrate, yields a strongly alkaline solution which absorbs carbonic acid from the air. This resists the further action of ethyl-iodide, so that hydro-cotarnine is a nitrile base, and its formation from cotarnine is parallel with that whereby acetylen is converted into ethylen. The prolonged action of ethyl-iodide on narcotine completely converts it into the ethiodide, but the product is not crystalline and is readily decomposed; the authors, however, succeeded in obtaining a platinum salt. Similar results were obtained with cotarnine, but the resulting compounds are more stable. The action of acetic anhydride on narcotine, cotarnine, and hydro-cotarnine were also tried, but with negative results.

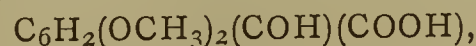
There are two appendices to this paper, one "*On the Physiological Action of the above-mentioned Ethyl Compounds*," by Dr. F. PIERCE; the other "*On the 'Structural' Formulae of Narcotine and its Derivatives*," by Dr. WRIGHT; in which, after reviewing the work of Matthiessen and Foster on this subject, also that of Liechti, he arrives at the conclusion that the formula of opianic acid is that indicated by Liebermann and Chojnacki—



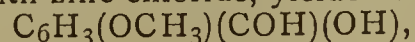
and consequently the structural formula of narcotine is—



Dr. ARMSTRONG, after remarking that Dr. Wright had not given any evidence in favour of the formula—



for opianic acid, said that some months ago he had stated before the Society that he had found that opianic acid, when heated with zinc chloride, yielded vanillin—



and had thence deduced the formula for opianic acid given above.

Dr. WRIGHT replied that he hoped shortly to lay before the Society Part III. of these researches, which contained the evidence for the formula of opianic acid; and the speaker then briefly stated several reactions which he had observed which tended to support the view that this formula represented our knowledge of the subject, especially the relation which exists between pyrocatechin and hemipinic acid on the one hand, and protocatechuic acid and opianic acid on the other.

Mr. W. NOEL HARTLEY then read a paper "*On the Presence of Liquid Carbon-Dioxide in Mineral Cavities.*" The author, after summarising what had already been published on this subject, especially noticing the observations of Davy and Brewster, described his experiments on a microscopic specimen of quartz with fluid cavities obtained from Mr. Norman. He observed that, on heating the specimen to 36°C ., the liquid disappeared completely, but returned on cooling; a determination of the critical point was, therefore, made, and was found to lie between 30.75° and 31°C .. Andrews's determination of the critical point of carbon dioxide places it at 30.92°C ., so that there can be no doubt as to the nature of the liquid in the quartz cavity examined. After the meeting, the author exhibited the specimen described.

The PRESIDENT, in thanking the author, observed that his application of Dr. Andrews's method was of great interest, and likely to throw considerable light on the nature of the liquids in the cavities of various minerals.

Mr. FIELD said it was very curious that quartz with these cavities was only found in certain districts; for instance, he only knew of two in the north of Chili, and in Cornwall, which was peculiarly rich in large quartz crystals, they were only found in the mine De la Bole, near Bos Castle. Mr. Talling told him he once possessed a cubic crystal of quartz, a pseudomorph, which contained about a fluid ounce of a liquid in a cavity.

Professor CHURCH had a crystal of fluor-spar from Cornwall which formally belonged to Sir David Brewster, and which had a cavity nearly half an inch long, partly filled with liquid.

The last paper was "*A Preliminary Notice on the Formation of Coumarin, Cinnamic Acid, and other similar Acids,*" by Mr. W. H. PERKIN. The author found that coumarin may readily be prepared by boiling salicylic aldehyd with acetic anhydride and sodium acetate. By treating benzoic and other aldehyds with the same reagents, they are found to yield acids, and, moreover, by varying the anhydride and the salt, a great variety of new acids can be obtained. Succinic anhydride and a succinate, when heated with benzoic aldehyd, also gives a beautifully crystalline acid. The following acids have already been prepared by this process and analysed:—Cinnamic acid, $\text{C}_9\text{H}_8\text{O}_2$; α and β methyl-oxycinnamic acids, $\text{C}_9\text{H}_7(\text{CH}_3\text{O})\text{O}_2$; phenyl-crotonic acid, $\text{C}_{10}\text{H}_{10}\text{O}_2$; phenyl-acrylic acid, $\text{C}_{11}\text{H}_{12}\text{O}_2$; cumenyl-acrylic acid, $\text{C}_{12}\text{H}_{14}\text{O}_2$; and cinnamyl-acrylic acid, $\text{C}_{11}\text{H}_{10}\text{O}_2$.

The PRESIDENT, having thanked the author for his most interesting communication, adjourned the meeting until the 2nd of December, for which several papers are announced, including "Communications from the Laboratory of the London Institution, by H. E. Armstrong; "On certain Bismuth Compounds," by M. M. P. Muir; "On the Decomposition of Alcohol and its Homologues by the joint action of Aluminium and its Halogen Compounds," by J. H. Gladstone and A. Tribe; "A Note on Incense Resin," by J. Stenhouse and C. E. Groves; and "Narcotine, Cotarnine, and Hydrocotarnine (Part III.)," by C. R. A. Wright and G. H. Beckett.

CORRESPONDENCE.

ON THE FLUORIDES OF ARSENIC AND PHOSPHORUS.

To the Editor of the Chemical News.

SIR,—As your report of the reading of my paper before the Chemical Society is apt to mislead your readers, I beg permission to make a few remarks regarding it. Your reporter states that I prepare arsenic trifluoride by distilling a mixture of arsenic trichloride, calcium fluoride, and sulphuric acid, whereas I use a modified Dubrunfaut's mixture, in which the arsenic-containing constituent is

the trioxide, and not the trichloride. Your report would, further, lead one to suppose that phosphorus trifluoride was a liquid boiling above 60°C ., which is not correct. PF_3 is a gas under normal conditions of temperature and pressure.

Regarding Dr. Armstrong's remarks, I shall, for the present, content myself with stating that, when PBr_3 or PCl_3 (preferably the former) is agitated with AsF_3 , a slow decomposition sets in, whereby heat is given out and PF_3 formed. The change may be much accelerated by the application of a gentle heat.—I am, &c.,

R. W. EMERSON MACIVOR.

NOTES UPON SUGAR ANALYSIS.

To the Editor of the Chemical News.

SIR,—I intended, as you would observe by my letter of the 15th inst., taking no notice whatever of your anonymous correspondents, "Beet" and "Cane," for the plain simple reason that I make it a rule never to reply to such. But having been invited by yourself to make an explanation, I think it is only a matter of courtesy to the readers of the CHEMICAL NEWS that I should do so.

With regard to the "similarity," &c., allow me to assure such that if there is such a similarity in existence it is purely accidental. A few of "the notes" in dispute were given me to copy from the laboratory books of a firm of analytical chemists when studying the subject some years ago with them; while others were given to me for a similar purpose by brother students working at the same benches and in the same laboratory. These extracts were copied into my own laboratory books, and from them were accidentally transferred by mistake to my "proof sheets," along with numerous other jottings of my own, when preparing the paper upon "Sugar Analysis."

Where all these notes were originally obtained the parties from whom I received them know best themselves. Certain am I that had I observed this sooner they would not by any means have been reprinted. For all the analytical work and experiments, including the section on the "Volumetric Estimation of Fruit-Sugar," I am indebted to myself.

Sir, I earnestly hope this explanation will give satisfaction to your numerous readers, and that you will give this note a corner in an early number of your journal.—I am, &c.,
G. C. STEWART.

Chemical Laboratory,
Cappielow Sugar Refinery,
November 20, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—Some of the conclusions of your correspondents on this subject do not quite agree with my own experience, which extends over fifteen years. Meantime, it would be of interest to elicit opinion as to a paragraph in the CHEMICAL NEWS vol. xxxii., p. 21, on "Sulphuric Acid Manufacture," by the late H. A. Smith, which is as follows:—"In several instances, also, which have come under my notice in the cases of manufactures of ammonium sulphate, many hundred pounds' worth of material has been lost through the use of acid containing this impurity (arsenic) while the unfortunate makers were vainly searching for their old enemy, iron."

This is somewhat enigmatical. How does the loss arise?—I am, &c.,

CARBON.

November 20, 1875.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—With reference to Mr. J. Carter Bell's letter on "Water Analysis" in the CHEMICAL NEWS (vol. xxxii.,

p. 249), I would ask whether Mr. Bell is quite satisfied that the bottles containing the samples were *clean*? As Public Analyst for the County of Cornwall I have frequently had samples sent in foul bottles. I also observe that the samples were taken at widely different times. Before blaming Messrs. A., B., C., D., and E., Mr. Bell should be quite certain that they had identically the same water to analyse.—I am, &c.,

J. H. COLLINS.

Truro, November 22, 1875:

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 18, November 2, 1875.

Fourteenth Note on the Electro-Conductivity of Bodies Sparingly Conductive.—M. Th. du Moncel.—This paper relates to the conductivity of metal filings, mineral dust, and moist bodies, living or inert. The filings of metal, dust of highly-conductive metallic ores, and that of graphite, or of retort-charcoal, are capable of conducting currents, but without determining electro-ionic effects of polarisation. If heated, their conductivity, at the first moment, seems to diminish more or less, but it afterwards augments rapidly to a great extent. If we cease to heat the current decreases successively, and its intensity becomes, after a time, much less than at first.

Laws which Govern Reactions of Direct Addition (Continuation).—M. L. Markovnikoff.—The author gives some details concerning his recent researches on the oxidation of propylenic chlorhydrin.

Unipolar Electric Excitement of the Nerves: Comparison of the Activity of the two Poles during the Passage of the Currents of the Battery.—M. A. Chauveau.—For every subject whose nerves are in a perfect physiological state there is an electric value—commonly very weak, sometimes moderate, but rarely very high—which gives to the two poles the same degree of activity in the case of unipolar excitement of the motor nervous bundles. The contractions produced by positive and negative excitement with this typical intensity of the current are equal, both in magnitude and duration. Below this intensity equal currents produce unequal effects with the two poles, the activity of the negative pole being more considerable. When tetanisation is produced by feeble currents it is never with the positive pole upon the nerve. Above the typical value of the intensity of the current the inequality appears in the opposite direction.

Bulletin de la Societe Chimique de Paris,
Nos. 6 and 7, October 5, 1875.

Compound of Methyl Oxide and of Hydrochloric Acid.—M. C. Friedel.—Not adapted for abstraction.

Detection and Determination of Arsenic contained in Animal Matters.—M. Armand Gautier.—The author maintains that there are many methods known which serve to demonstrate the presence of arsenic in animal matter, but that none of them can be depended upon for its quantitative determination, as they are unable to extract from any tissue the whole of the arsenic which it may have absorbed. He concludes, however, that this may be effected by Marsh's process, if the organic matter is previously dealt with as follows:—100 grms. of the suspected substance are cut in pieces, and introduced whilst recent into a porcelain capsule containing 600 c.c. It is treated with 30 grms. of pure nitric acid, and moderately heated. The substance liquefies by degrees, then thickens, and takes an orange tint. The capsule is then withdrawn

from the fire, and 5 grms. of pure sulphuric acid are added. The mass turns brown, and is briskly attacked. It is heated until vapours of sulphuric acid begin to escape. 10 to 12 grms. of nitric acid are then poured drop by drop upon the residue. The substance liquefies again, giving off abundant nitrous fumes. It is then heated to incipient carbonisation. The matter thus obtained is powdered, and exhausted in the capsule with boiling water. The filtrate is treated with a few drops of sodium bisulphite, and the arsenic is then thrown down as sulphide by a prolonged current of sulphuretted hydrogen. This sulphide is converted into arsenic acid by ordinary methods, and poured into Marsh's apparatus.

The Prussiates.—M. Gaston Bong.—Ferrocyanide of potassium, by its ready transformation into ferricyanide under the influence of chlorine, can be used for chlorometric operations with as much precision and ease as arsenious acid. For this purpose we employ a normal solution containing 37.765 grms. prussiate per litre, a quantity corresponding to a litre of chlorine. Of this 10 c.c. are taken, diluted with water, and acidulated with hydrochloric acid. After the solution has been coloured with a few drops of sulphate of indigo, the chlorinised solution in question is poured in until the blue colour of the indigo gives place to the brown colour ferricyanide of potassium. Determinations of yellow prussiate by means of a standard chlorine liquid can also be made in the same manner, using solution of indigo to ascertain the end of the operation, which is much preferable to the ordinary method of "spotting" with perchloride of iron. The author treats, further, on the application of yellow prussiate in acidimetric operations; and on the oxidising power of the ferricyanides—those especially of zinc, copper, and mercury—in presence of an alkali. He remarks that the three above-named ferricyanides produce aniline-black immediately at common temperatures, whilst the other metallic ferricyanides effect the same change only at elevated temperatures. The author has also examined the purple produced by the reaction of alkaline sulphides with the nitro-prussides, and announces the discovery of a new class of prussiates.

Gyratory Movement of Certain Salts on the Surface of Water.—M. H. Lescœur.—Substances possessing the epipolic force may be arranged in two classes:—1. *Bodies Insoluble in Water.*—When once they are spread out all motion is arrested, and the movement of every other body is suspended (fixed oils, fatty bodies, &c.). 2. *Soluble or Volatile Bodies.*—The superficial layer produced instantaneously dissolves, or is volatilised. The movement is continuous. The saturation of the liquid and ambient air causes all activity to cease (camphor, acetic acid, essential oils, &c.). As to the first cause of the motion, it is found in the reciprocal action of two fluid surfaces. It may be a phenomenon of capillarity, or of the superficial tension of the liquids.

Metallic Derivatives of Cyanamid and of Dicyanodiamid.—M. R. Engel.—Not adapted for abstraction.

Density of Leucin.—MM. Engel and G. Vilmain.—The specific gravity of leucin at 18° was found to be 1.293.

Volumetric Determination of Molybdic Acid.—M. A. Werncke.—M. Pisani has proposed to determine molybdic acid by reducing it to sesquioxide with zinc and hydrochloric acid, and finding then the amount of permanganate of potash needful for its re-conversion into molybdic acid. The author finds that the reduction thus obtained is not complete, and sodium-amalgam gave also an imperfect reduction. The results obtained are, however, mutually comparable.—*Zeitschrift für Analytische Chemie.*

Volumetric Determination of Sulphuric Acid in Waters.—M. W. Hempel.—Prepare a solution of nitrate of barium containing 5 grms. per litre, and a solution of potassium chromate equivalent to the former. To 100 c.c. of the water in question add a volume of the barytic solu

tion sufficient to precipitate the total sulphuric acid, and determine then by means of the solution of potassium chromate the excess of the baric salt added, using, in order to recognise the end of the reaction, a drop of silver nitrate upon a white porcelain plate. When there is an excess of the chromate the drop assumes at once a reddish brown colouration; a colouration which only appears after some time is due to the decomposition of the barium chromate suspended in the liquid by the silver nitrate. The results obtained are very satisfactory.—*Zeitschrift für Analytische Chemie*.

Determination of Small Quantities of Cobalt in Nickel.—M. Fleitmann.—When a liquid contains only 1 part of cobalt to 100 of nickel, the separation cannot be effected by means of potassium nitrite on account of the solubility of the double nitrite of potassium and cobalt. In this case the author proposes to precipitate the cobalt along with a certain quantity of nickel (about twice its own weight) by adding to the solution a suitable quantity of hypochlorite of soda. This salt throws down, first, the cobalt as brown peroxide, and afterwards the nickel as black peroxide. When about 2 parts of nickel have been precipitated, for 1 part of cobalt existing in the liquid we may be sure that only a trace of cobalt remains in solution. With a little practice it is easy to decide from the colour of the precipitate whether enough hypochlorite has been added. The precipitate is washed, dissolved in hot hydrochloric acid, and precipitated with potassic nitrite, observing the known precautions.—*Zeitschrift für Analytische Chemie*.

On Filtration.—M. Fleitmann.—The author remarks that a filter fitting closely to the funnel acts less rapidly than a double filter of the same texture, and this again less rapidly than a threefold filter.—*Zeitschrift für Analytische Chemie*.

Separation of Tin from Antimony and Arsenic.—M. C. Winkler.—If the substance is an alloy dissolve in a mixture of 4 parts of hydrochloric acid, 1 part nitric acid, and 5 parts water, adding so much tartaric acid that the solution may not become turbid on the addition of water. If the three elements are in the state of sulphides, they are dissolved in dilute potassa; chlorine is passed into the solution, and bromine added until these two bodies are in excess. The liquid is then neutralised with hydrochloric acid, and tartaric acid is added. In either case the solution is diluted to 300 or 400 c.c., and a solution of chloride of calcium added in such quantity that the carbonate of lime precipitable therefrom may be about fifteen times the weight of the tin in the solution. Neutralise with carbonate of potash, precipitate the tin with cyanide of potassium, and finally throw down the calcium of the chloride with a slight excess of carbonate of potash. Under these conditions the tin is deposited alone, the antimony and arsenic remaining in solution. The liquid is boiled to render the precipitate of calcic carbonate more dense, and that it may imprison the gelatinous stannic acid and permit it to be washed. When the precipitate is settled it is three times washed with boiling water by decantation. If an absolutely exact separation is required the precipitate is re-dissolved in a little hydrochloric acid, and re-precipitated with cyanide and carbonate of potassium as before. Lastly, the precipitate is thrown on a filter, washed, dried, and ignited to convert the stannic acid into the insoluble modification. Lastly, it is treated with hydrochloric acid, which removes the lime. The residue is then collected on a small filter, washed, ignited, and weighed.—*Zeitschrift für Analytische Chemie*.

Determination of Nitric Acid in Water.—M. F. Gramp.—The author finds that sodium-amalgam in presence of an excess of potassa is the best agent for reducing nitric acid to ammonia. For 0.1 grm. nitrate of potash dissolved in 60 grms. of water he employed 40 grms. of sodium amalgam, and found that the whole of the nitric acid was converted into ammonia without any loss.—*Journal für Praktische Chemie*.

Ebony-Black Stain for Wood.—E. Lauber.—Extract of logwood is dissolved in water till the liquid stands at 10° B.; 5 litres of this solution are mixed with half the measure of pyrolignite of iron at 10° B., and 0.5 litre acetic acid at 2° B., and the mixture is then heated for a quarter of an hour.

Nos. 8 and 9, November 5, 1874.

Synthetic Researches on the Uric Group.—M. Edouard Grimaux.—This long and important paper is not suited for abstraction.

Certain Ferro-Cyanides.—M. A. Atterberg.—The author has prepared and examined the ferrocyanides of molybdenum, tungsten, uranium, vanadium, niobium, tantalum, titanium, tin, tellurium, antimony, and bismuth.

Certain Glucinium Compounds.—M. A. Atterberg.—The author describes the chloride of glucinium and ethylic ether, the basic chloride, the platino-cyanide, phosphate, and two arseniates of glucinium.

Formation of Alizarin by the Reduction of Rufigallic Acid.—M. O. Widman.—On treating rufigallic acid with water and sodium amalgam the result is a violet solution, which is saturated with hydrochloric acid. The precipitate is washed and dissolved in potassa. Chloride of barium then determines a precipitate which is decomposed with hydrochloric acid. The insoluble residue is dissolved in methylic alcohol or acetic acid, the solution is evaporated to dryness, and the residue heated to 250°. It sublimes then in very brilliant, orange-red, crystalline needles, which, on analysis, give—

| | |
|------------------|-------|
| Carbon | 69.54 |
| Hydrogen | 3.92 |

The formula of alizarin requires—

| | |
|------------------|-------|
| Carbon | 70.00 |
| Hydrogen | 3.33 |

The reactions of the body thus obtained are the same as those of alizarin. The formation of alizarin by rufigallic acid indicates that this acid is hexa-oxyanthraquinon, according to the conclusions of M. Jaffe. This fact easily explains the formation of alizarin in the vegetable kingdom.

Correspondence from St. Petersburg, May 3rd (15th).—M. W. Louguinine.—The death is announced of the distinguished young chemist, M. Michel Kirpicheff. M. Mendeleef describes a new and very sensitive differential thermometer. He also points out that he had described, in 1868, the hydrate $\text{NaCl} \cdot 10\text{H}_2\text{O}$, of which Dr. Guthrie gives an account in the *Philosophical Magazine*, No. 1, 1875. M. Boutlerow, on behalf of M. Setschenoff, announces that by the prolonged reaction of carbonic acid upon a solution of sodic acetate, saturated at ordinary temperatures, carbonate of soda is formed, whilst acetic acid was set free. On behalf of M. Popoff he also presented a paper on the communication of M. Markownikoff on the oxidation of α -oxybutyric acid. M. Wischnegradsky described three new pinacolins obtained synthetically, setting out from the chlorides of tertiary oxides and from zinc-organic compounds. M. Menschoutkine, on the part of M. Kern, described certain reactions of metallic sodium upon chloroform, and the composition of certain metallic alloys. On behalf of M. Ossipoff he gave an account of the action of sulphuric acid, of different degrees of concentration, upon amylen. On behalf of M. Trapp he described a new camphor obtained by distilling large quantities of the flowers of *Ledum palustre*. The fourth part of the seventh volume of the *Journ. de la Soc. Chim. Russe* contains, also, a preliminary notice by MM. Petrieff and Eguis, "On the Action of Sodium-Amalgam on the Neutral Ethers of Certain Mono-Basic Acids;" a paper by M. W. Roudneef "On the Products of the Reduction of Trichloro-lactic Acid;" a memoir by M. Wischnegradsky, "On the Condensation of Iso-Amylen;" and a preliminary notice by M. Kazantzeff, "On the Action of Hydriodic Acid on Aceton and Phoron."

Tannic Acid of Divi-Divi.—M. J. Löwe.—The tannin of divi-divi, the pods of *Casalpinia coriaria*, is little known:

according to Stenhouse it differs from gallo-tannic acid. The author confirms this view: he has prepared the tannin of divi-divi in a state of perfect purity. He names it ellago-tannic acid, and finds that it is a yellow powder, which, when dried at 100° , yields on analysis $C = 49.70$, and $H = 3.16$ per cent. These figures indicate the formula $C_{14}H_{10}O_{10}$, which differs from that of gallo-tannic acid by containing one more atom of oxygen. It possesses reactions resembling those of ordinary tannin. It precipitates solutions of gelatin, albumen, the alkaloids, and tartar-emetic. It yields with acetate of lead a yellowish drab precipitate, which, when dried at 100° , contains— $2(C_{14}H_{10}O_{10})_5PbO$; with acetate of copper it gives a light brown, and with acetate of iron a black precipitate. If heated for some hours to 108° to 110° the aqueous solution becomes turbid, and deposits a pale powder, the composition and properties of which agree with those of ellagic acid, $C_{14}H_6O_8$. The ellago-tannic acid has, therefore, merely lost 2 molecules of water. It is known that impure gallo-tannic acid yields, likewise, a certain amount of ellagic acid under the influence of dilute acids, whilst the pure acid does not display this reaction. It is probable, therefore, that crude tannin, besides gallo-tannic acid, contains some ellago-tannic acid. Divi-divi contains gallic acid along with ellago-tannic acid.

Tannic Acid of Myrobalans.—M. J. Lœwe.—The tannin of myrobalans is identical with that of divi-divi. It has the same composition, properties, and decompositions.—*Zeitschrift für Analytische Chemie*.

Tannin of Hungarian Galls.—M. J. Lœwe.—The gall of Hungary and Piedmont is an anomaly of the cup of the acorn of the common oak, occasioned by the sting of a cynips. It is used in tanning. The galls contain an inconsiderable amount of a tannin which the author finds identical with that of gallo-tannic acid, $C_{14}H_{10}O_9$.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 23, November, 1875.

Report Given in by M. de Luynes, in the Name of the Committee of Economical Arts, on the Processes of M. de la Bastie for Tempering Glass.—The Committee consider that the chief objection to the use of tempered glass is the difficulty of cutting it with a diamond.

Report Delivered by M. Salvétat, in the Name of the Committee of Chemical Arts, on the Work of MM. Girard and de Laire, entitled "Traité des Dérivés de la Houille" (Treatise on the Derivatives of Coal).—A critique on an excellent work, which now comes decidedly too late.

The other chemical papers in this issue have been already noticed.

British Rivers. Things not Generally Known.—The New York *Graphic* tells us that "the pollution of rivers is a topic that taxes the attention of British sanitarians to the utmost. The extent of the difficulty is certainly alarming. Nor is it caused solely by the sewage of cities and towns, bad as that is. The rivers are lined with manufactories of all sorts, chemical works, machine shops, and dye houses, all of which pour their poisonous refuse into the rivers. And so great is the pollution of the water in some instances that when a light was applied to some of it dipped from the river at Bradford it actually burned. A man who accidentally tumbled into a river and swallowed a mouthful of water died of the effects. The effluvia that rises from the Clyde produces sickness in summer time, and the Mersey emits an unbearable stench. The water of the Bourne is yellow as ochre and thick as glue, and the horse that drinks it dies. And all the rivers are more or less affected in the same way, and the fish that survive in some of the streams are so unwholesome that they are unfit for food, if not dangerous."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of starch and starchy substances, and the production therefrom of a compound body capable of being used as a substitute for malt in brewing, and for other purposes. Cornelius O'Sullivan, brewer, Burton-on-Trent, Stafford, and William George Valentin, of the Royal College of Chemistry, South Kensington, Middlesex. November 12, 1874.—No. 3909. This invention consists in producing from starch or starchy substances a compound solid body which the inventors term "dextrin-maltose," consisting of the same proportional quantities of dextrin and maltose as are ordinarily obtained from malt by the mashing process. To 100 parts by weight of starch 250 parts by weight of water are added, and from $1\frac{1}{2}$ to 2 parts by weight of concentrated sulphuric acid. The mixture is then digested at the temperature of boiling water until the solution contains the requisite proportions of dextrin and maltose, when the acid is neutralised by means of calcic hydrate or carbonate. The solution is afterwards freed from the insoluble calcic sulphate which has been formed, and when evaporated to dryness yields the solid "dextrin-malotse."

Improvements in preserving animal and vegetable substances. J. G. Tongue, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Edouard Vincent Jules Laurent Gorges, chemist, Paris.) November 17, 1874.—No. 3946. This invention relates to a new process or means of preserving animal and vegetable substances in their natural state. In order to preserve a whole animal or carcass, sulphurous gas is forced into the white tissues between the skin and the flesh; this is obtained by means of an india-rubber tube and bellows in communication with a bottle or chamber containing liquid bisulphate of soda, lime, or manganese. A liquid containing 1 per cent of pure chloric acid, or any other acid which is not injurious to health, is then forced into the carotid artery or aorta. The animal having been skinned, and the entrails taken out, when the carcass is cold it is submerged in a bath composed of a solution similar to that above described. In order to preserve the flesh of fish, wash it well in a solution containing about 1 per cent of chloric acid; and it may then be kept in a solution containing phosphate of soda dissolved, and an addition of 3 per cent of chloride of sodium. In order to preserve all kinds of vegetables, they must be kept one or two minutes in boiling water, then left to cool, and afterwards put into tin boxes, bottles, or casks, which are then filled with water containing 10 per cent of phosphate of soda, or any other salt of soda; add 1 per cent of carbonate of soda and salt. Mushrooms are preserved by being kept for one or two hours in a solution containing 5 or 6 per cent of any kind of sulphate or bisulphate of soda or lime, then submerged into boiling water during one or two minutes, and after cooling in the first solution they are put into bottles or tin boxes, and filled with a solution similar to the preservation of vegetables as above described, or one or two per cent of any kind of bisulphate may be used. All kinds of fruits may be preserved in their natural state by being kept in a solution saturated with any kind of salt of soda, tartrate, chlorite, phosphate, and with an addition of sugar.

Improvements in the manufacture of sugar for brewing and other purposes. W. Garton, Southampton. November 17, 1874.—No. 3950. This Provisional Specification refers to the manufacture of sugar composed partly of dextro-glucose obtained from amylaceous substances, and partly of lævo-glucose obtained from cane or other sugar-producing substances. When amylaceous substances are being converted into dextro-glucose by means of acid and heat in the ordinary way, the conversion ceases as soon as the solution has attained a specific gravity of about 1.070, and it has then been usual to neutralise it, and to concentrate it by evaporation. On the other hand, in treating cane or other sugar to obtain lævo-glucose, an inversion may be effected in solutions of specific gravity of even 1.200 to 1.275. Now, according to this invention, when the solution containing the amylaceous substances has reached the point beyond which no further conversion can be effected, the inventor takes advantage of a fact which he has ascertained by experiment, viz., that the acid employed in converting is further capable of inverting large proportions of crystallised sugar, while the glucose obtained from the amylaceous substance is still in the solution. He therefore adds sufficient cane- or beet-sugar to increase the gravity to about 1.275, and when the inversion is complete he neutralises the acid solution containing both the dextro- and lævo-glucose. Great economy is thus effected.

Improvements in separating tin and zinc from iron and other impurities, and also in separating from silver and lead the zinc which has been employed in desilverising the lead. F. W. Dahne, Swansea, Glamorgan. November 19, 1874.—No. 3978. This invention mainly relates to separating zinc, tin, and other metals which have been used for galvanising and such like purposes, by using as prescribed the muffle as ordinarily employed, with a charge or bed of coal, coke, charcoal, or other suitable material, which the inventor terms a filter. In this muffle so charged a small opening is left in the lower part. The action is in general terms described in the Provisional Specification.

Improvements in the manufacture of beer. C. Laubarede, Percy Street, Fitzroy Square, Middlesex. (A communication from V. P. C. Baud and A. A. Saulxures, Paris.) November 19, 1874.—No. 3982. Maize is steeped in a solution in water of sulphite, bisulphite, or hyposulphite of potash, soda, or lime, and then exposed to the influence of the atmosphere until it is dried on the surface. The maize is then broken into particles by the action of a grinding mill, and can be dried and preserved, or may be used in a moist state. In either case it is combined with barley-malt and employed for the purposes of brewing.

MEETINGS FOR THE WEEK.

- SATURDAY, Nov. 27th.—Physical, 3. "On Stationary Waves," by Dr. F. Guthrie. Exhibition of Dr. Kerr's experiments on the influence of electrification on polarised light.
- MONDAY, 29th.—Royal Geographical, 8.30.
— Medical, 8.
— Society of Arts, 8. Cantor Lectures: "On the Discoveries and Philosophy of Liebig, with Special Reference to their Influence upon the Advancement of Arts, Manufactures, and Commerce," by Dr. Thudichum.
- TUESDAY, 30th.—Civil Engineers, 8.
— Royal, 4. (Anniversary.)
- WEDNESDAY, Dec. 1st.—Society of Arts, 8. "On the Legislative Enactments requisite for Safe Conduct of Sewage Grounds," by Alfred Smee, F.R.S.
— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.
- THURSDAY, 2nd.—Chemical 8. "On certain Bismuth Compounds," by M. M. Pattison Muir; "On Bismuthiferous Tesserall Pyrites," by Dr. William Ramsay; "On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by Dr. Gladstone and Mr. Tribe; "Note on Incense Resin," by Dr. Stenhouse and Mr. Groves; "On the Occurrence of Native Calcium Chloride at Guy's Cliff, Warwickshire," by J. Spiller. "On Certain Sources of Error in the Ultimate Analysis of Organic Substances containing Nitrogen," by G. S. Johnson.
— Society of Arts, 8. Adjourned discussion on the paper by H. T. Wood, B.A., "On the Registration of Trade Marks."
- FRIDAY, 3rd.—Geologists' Association, 8.
— Society of Arts, 8. Special Lectures: "On Unhealthy Trades," by Dr. B. Richardson (Lecture I.).

TO CORRESPONDENTS.

P.H.—A correspondent suggests that you may find the information you require in "Traité Complet, Théorique et Pratique de la Fabrication du Sucre, Guide du Fabricant," published at 20 francs. Eugène Lacroix, Paris.

G. Evans.—Apply to the Secretary, Burlington House, Piccadilly, London, W.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums, received since the 16th instant:—

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VOL. XXXII. No. 836.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

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AMONGST the nuisances defined in the various Acts of Parliament, general and local, are those occasioned by the operations of trade and industry. Sections 27 and 28 of the Amended Nuisances' Removal and Diseases Prevention Acts (18 and 19 Vict., c. 121) express in a general way the character of these nuisances and the methods of procedure in cases of default. "If any candle-house, melting-house, melting-place, or soap-house, or any slaughter-house, or any building or place for boiling offal or blood, or for boiling, burning, or crushing bones, or any manufactory, building, or place used for any trade, business, process, or manufacture causing effluvia, be at any time certified to the local authority by any medical officer, or any two legally qualified medical practitioners, to be a nuisance or injurious to the health of the inhabitants of the neighbourhood, the local authority shall direct complaint to be made before any justice, &c., for the suppression or mitigation of the nuisance complained of;" and by the Sanitary Act, 1866 (29 and 30 Vict., ch. 90, s. 18), a like power of initiating proceedings is given to any ten ratepayers of the place in which such nuisance exists, on a requisition in writing to the local authority. In case of such procedure, it is necessary, not only to show that the trade or business complained of "is a nuisance, or causes effluvia injurious to the health of the inhabitants of the neighbourhood," but also that the person complained against has not "used the best practicable means for abating such nuisance, or preventing or counteracting such effluvia."

It follows, therefore, that the supervision of such trades and manufactures, and the maintenance of them in such condition as that the best practicable means are constantly used to prevent the escape of offensive effluvia, forms one of the most important duties of the Medical Officer of Health; and as, in a professional capacity, I have had occasion frequently to visit and inspect most of the manufactories belonging to this category, I have thought that a brief account of my experience in the matter might be acceptable to my professional colleagues.

And here I ought to state that, on entering upon any inquiry of this description, it is proper to keep in mind the evident intentions of the Legislature, namely, the maintenance of the public health and comfort with due regard for the necessities of industry; for it will be observed that, although the preservation of the public health has been considered by Parliament of such paramount importance as to justify enactments containing enormous arbitrary powers, yet the exercise of those powers is always guarded with such provisos as will prevent abuse, and, thereby, unnecessary injury to trade. It is fortunate that, in most cases, the interests of the public and the manufacturer, although apparently conflicting, are really in accordance; for that which is injurious to the public is frequently a

wasteful loss to the manufacturer; and therefore the prevention of such waste by reasonable contrivances has a double advantage. This may not be apparent at first sight to the chief parties interested, for it has often happened in the course of my professional practice that the suggestions which I have offered for the mitigation of a nuisance have not been readily accepted by the manufacturer, although in the end they have been gratefully acknowledged. I cannot, indeed, too strongly impress upon the minds of all who are concerned in such inquiries, that there need not be a feeling of antagonism in the matter; for if at any time it exists, it is either caused by a want of confidence in the skill and technical knowledge of the professional adviser of the local authority, or by an unjust and exaggerated view of the necessity for providing for the public health and comfort at all costs. This is manifestly in opposition to the spirit of the Acts of Parliament, so far as local authorities are concerned, for their duties are to see that the best practicable or available means are adopted to prevent the escape of noxious or offensive effluvia. If that fails to abate the nuisance complained of, the parties aggrieved have their remedy at law or in equity in one of Her Majesty's superior courts. On the other hand, as Mr. Keane observes, the manufacturer is bound to use the best practicable and available means to protect the public from annoyance or injury to health. It will not be enough to adopt such precautions only as are used in the place or district among persons carrying on the same business or manufacture, if it has been ascertained that there are better which are available; and in interpreting the words available and practicable, it is probable that the magistrates will pay more attention to scientific than pecuniary difficulties. It is of great importance, therefore, that the opinions of the Medical Officer of Health should be well founded, and his recommendations free from reasonable objections, for it must not be forgotten that the manufacturer, if he thinks himself aggrieved, has the right and power of appeal from the justices to a superior court, where the knowledge and judgment of the medical officer will be severely tested.

But, besides the nuisances which are caused by manufacturing operations, there are others which are more or less incidental to them, as well as to other branches of trade and industry. "Any accumulation or deposit which is a nuisance or injurious to health; or any pool, ditch, gutter, or watercourse, so foul as to be a nuisance, or injurious to health" (18 and 19 Vict., c. 121, s. 8); or "any factory, workshop, or workplace, not already under the operation of any general Act for the regulation of factories, or bakehouses, not kept in a cleanly state, or not ventilated in such a manner as to render harmless, as far as practicable, any gases, vapours, dust, or other impurities generated in the course of the work carried on therein, that are a nuisance or injurious to health;" and "any fireplace or furnace which does not, as far as practicable, consume the smoke arising from the combustible material used in such fireplace or furnace;" and "any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance" (29 and 30 Vict., c. 90, s. 19)—all of which are under the supervision of the Medical Officer of Health, with a view to legal proceedings in case of default.

Looking at the individual peculiarities of these nuisances, it is evident they may be conveniently classified under three heads, namely:—

- (1). Those which are caused by the escape of noxious or offensive effluvia, as gases and vapours.
- (2). Those which are produced by smoke, dust, or other mechanical impurities.
- (3). Those which are occasioned by the discharge of noxious or offensive matters into gutters, ditches, or water-courses.

It will not be possible to discuss in a satisfactory manner the whole of these subjects in this paper, and therefore I propose to limit your attention to the first of them, namely, to those trade nuisances which are caused by the escape

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

of noxious and offensive effluvia, as sulphuretted hydrogen, empyreumatic or other organic vapours, and the gaseous acids.

Foremost of those operations which cause offence by the escape of *sulphuretted hydrogen* into the atmosphere is the manufacture of *sulphate of ammonia* from gas liquor. This liquor is produced in great quantity at the gas-works—varying from 10 to 40 gallons per ton of coals, according to the strength of the liquor and the perfection of the processes for removing ammonia from gas. The strength of the liquor is estimated and expressed by its gravity in degrees of Twaddell, or by the number of ounces of strong sulphuric acid (sp. gr., 1.850) required to saturate a gallon of it. This varies from 5 or 6 ounces per gallon to 25 ounces, and, according to my experience, the proportion of sulphuretted hydrogen contained in it ranges from 230 grains, or rather less than one-third of a cubic foot per gallon, to rather more than 1250 grains, or nearly 2 cubic feet per gallon; so that the liquor is exceedingly offensive from the quantity of sulphuretted hydrogen contained in it; and therefore it is necessary to store it in air-tight tanks, and to transport it from place to place in air-tight vessels—as barrels or tank-barges, or tank-trucks. It is proper also that the orifices which give exit to the air at the time of filling the tanks should be guarded with a box or small barrel containing hydrated oxide of iron, which absorbs the sulphuretted hydrogen, producing sulphide of iron, which is subsequently revived by the action of the air.

The methods of treating this liquor with sulphuric acid so as to produce sulphate of ammonia have differed at different times and places. In my early experience, even in this metropolis, the process was to neutralise the liquor with brown acid of sp. gr. 1.720, and to convey the evolved gases into a furnace fire, as their escape into the air would be dangerous to the workmen; and the saturated liquor still reeking with sulphuretted hydrogen was evaporated in open lead troughs over open fires. The nuisance arising from these operations was absolutely unbearable; and as people got to be more and more sensitive of annoyance, the old process was discontinued. At the present time the practice is to evaporate or distil the liquor from closed boilers or chambers, and to convey the volatile products—ammonia, carbonic acid, and sulphuretted hydrogen—into a closed chamber, or saturator, containing weak sulphuric acid, there being a contrivance for the escape of carbonic acid and sulphuretted hydrogen, and the conveyance of them to a furnace fire. In some cases the liquor is distilled from boilers set over a common fire; but, as this is liable to flushes and irregularity in working, it is objectionable, and has given place to the process of distilling by means of a steam coil set in the boiler, by which steam at from 20 to 30 lbs. pressure is blown into the liquor. But the best contrivance of all is that known as Coffey's still, which consists of a vertical chamber from 20 to 25 feet in height, having a series of transverse septa which alternately leave an opening at their ends. In this way, with about sixty of such septa, a superficial area of about 1000 square feet of evaporating surface may be obtained. The liquor is delivered in a constant and graduated stream at the top of the chamber, and as it flows backwards and forwards in a descending current over the transverse septa, it meets with an ascending blast of steam which is let into the bottom of the chamber at a pressure of from 15 to 30 lbs. In this way the volatile constituents of the liquor are carried over to the saturator, where the ammonia is arrested by sulphuric acid, and the exhausted liquor flows out in a continuous stream from the bottom of the chamber. The saturator is generally an air-tight leaden vessel, about 4 or 5 feet square and 3 or 4 feet deep, containing a charge of diluted sulphuric acid—equal parts of chamber acid (1600) and water. When the acid is saturated with ammonia, which is known by test-papers, steam alone is blown into it from the still for about half an hour to displace all traces of sulphuretted hydrogen, and the solution is drawn off into open pans or

troughs, where it is evaporated by means of a closed coil of high pressure steam set in the solution.

Another kind of saturator occasionally in use is a leaden vessel divided into two compartments by a diaphragm or curtain, which descends below the liquid to within about 18 inches of the bottom. One of these compartments is closed air-tight and receives the volatile products of the still, where they meet with a graduated stream of brown acid (sp. gr. 1.720), which continually neutralises them, and forms crystals of sulphate of ammonia, which are constantly ladled out of the open compartment. The apparatus is ingenious, and saves much labour and time in evaporation, as the acid is used in its undiluted condition; but it is not so certain or satisfactory in its action as the closed saturator before described.

In both cases the uncondensed gases—sulphuretted hydrogen and carbonic acid—with much steam, are conveyed from the saturator through a 4-inch pipe to the furnace fire, where the sulphuretted hydrogen is burnt. It is necessary, however, that the sulphuretted hydrogen should be deprived of its moisture before it reaches the fire, or it will extinguish it; and this is effected by throwing the pipe into coils, or otherwise cooling it. The precautions, therefore, to be taken in the conduct of this business are:—

(1). The transport and storage of the gas liquor in air-tight tanks guarded with boxes of hydrated oxide of iron.

(2). The distillation of the liquor in a steady and continuous manner in air-tight stills by means of high-pressure steam.

(3). The saturation of the ammonia in close vessels, and the complete expulsion of sulphuretted hydrogen from the saturated solution before it is drawn off for evaporation.

(4). The condensation of moisture from the sulphuretted hydrogen evolved from the saturator; and the conveyance of the cold dry gas to the furnace fire where it is to be completely burnt.

(5). The treatment of the exhausted liquor from the still with cream of lime, so as to recover the residual ammonia by a second distillation; or, if the process be in operation at a gas works, the use of the residual ammonia as an absorbent in the purification of gas.

(6). The observance of the greatest care as regards the tightness of all parts of the apparatus.

Another operation which demands care in its management is the *distillation of coal-tar* for the various products derivable from it. There are two kinds of tar from coal, according as the temperature of distillation is high or low, and according to the richness of the coal in hydrocarbon. One is ordinary coal-tar, and the other is the tar from which paraffin oils are obtained. The tar produced from common coals at a high temperature (common coal-tar) is always heavier than water (sp. gr., 1.120 to 1.150); it dries freely in the air by oxidation; it contains hydrocarbons with such an excess of carbon that they cannot be burnt in a common lamp; it is almost entirely destroyed by strong oil of vitriol; it contains much sulphur, and its percentage composition is about 86 carbon, 7 hydrogen, 6.5 oxygen, and 0.5 sulphur. Whereas the tar produced from cannel coal at a low temperature is lighter than water (sp. gr., about 0.900); it will not oxidate, or dry in the air, it contains hydrocarbons of the paraffin series which are comparatively poor in carbon, and which can be burnt in a lamp; it is not much acted on by oil of vitriol; it contains little or no sulphur; and its percentage composition is about 84 carbon, 12 hydrogen, and 4 oxygen. Both of these tars are the subjects of technical manipulation, and if not properly managed are the cause of nuisance, as are also the processes used in their primary production. In dealing with ordinary coal-tar, it is proper that it should be stored and carried in air-tight tanks, and left covered with a little water. The delivery of it into tank-barges or tank-trucks, and from them into the tanks of the works,

should be by means of pumps and air-tight flexible hose; and the openings of the barges and tanks should be guarded with a box containing hydrated oxide of iron, as in the case of ammoniacal liquor.

The distillation of coal-tar is always conducted in iron stills set over a naked fire—the stills are of varying capacity, from 1200 to 5000 gallons, and the crown of them is always protected with brick-work to keep them hot, so that the later volatile products may not cool and condense and fall back into the still. The time of the distillation of a charge is from twelve to fifteen hours, according to the capacity of the still; and the products are first condensed in a worm or pipe kept cool in water, from which they are received into a specially-contrived box (varying in form and construction at different places), which permits the several products to flow away by separate pipes (four or five in number, and each provided with a tap) to their several tank receivers. This box is made air-tight (its cover being guarded by a water-valve), and it is provided with an ascending-pipe, which carries the foul gases to proper purifiers before they pass into the furnace-shaft. The gases which are evolved during the process of distillation are, first sulphuretted hydrogen from the ammoniacal liquor which always accompanies the tar, then gaseous or uncondensable hydrocarbons, and finally the acrid vapours of the superheated pitch with an abundance of sulphuretted hydrogen. These gases and vapours should be made to pass, first through a vertical condenser or scrubber charged with a stream of cold water, and then through an oxide of iron purifier with two or three trays of oxide, and finally to the furnace-shaft. The necessary draft for these operations should be secured by means of a fan, or by the aid of the furnace-shaft. It is proper to mention that, unless there is a draft of considerable power, the unavoidable leakage from the constantly loosening joints of the pipes will not be prevented. It is right, also, to state that it is dangerous to convey these gases and vapours into a furnace fire, as they are explosive when mixed with air, as they necessarily will be.

The products of the distillation of coal-tar vary in different places. At one time they were but four, namely:—First, ammoniacal liquor and very light naphtha, which come over before the tar in the still begins to boil; second, a crude naphtha which floats upon water, and is therefore called "light oil;" third, a creosote oil which sinks in water, and is called "heavy oil;" and fourth, the residuum, which is a soft pitch. At present, however, in well-conducted works, the creosote or dead oil is run off in two portions, namely, an early portion, consisting of creosote and heavy naphtha, which is used for burning in furnaces; and a later portion, which is best suited for the preservation of timber. This is followed by a greenish oil, which is sometimes collected apart and re-distilled with the anthracen oil that runs from crude-pressed anthracen; and then follows a green oil (anthracen oil), which is allowed to flow until it gets very thick from the presence of chrysen—the residuum in the still being hard pitch. It is in the later stages of the process, when the high temperature of the still causes the decomposition of the pitch, that sulphuretted hydrogen and acrid vapours are evolved; and this also is the cause of the nuisance from the hot pitch when it is run off from the stills into open pits. To guard against this, it is proper that the fire should be raked out from under the stills directly the process is over, and the pitch should remain in the stills to cool for ten or twelve hours; it should then be run into close receivers, or into a properly constructed chamber, and allowed to cool for twenty-four hours before it is discharged into the final receiver. All these should be ventilated so as to convey the vapours through the scrubbers and purifiers before mentioned. An excellent form of receiver for the pitch from the stills is a long air-tight chamber, which will bear internal pressure, and which communicates at the bottom with an outside trough, into which the cool pitch is forced by the weight of the hot pitch at each time of its discharge from a still. The pitch, when cooled to a tem-

perature of about 180° or 190° F., may be freely exposed to the air, and be either run into pits or ladled out into moulds.

(To be continued).

ON CHROMEISEN, AND ON SOME OTHER ALLOYS.

By SERGIUS KERN, St. Petersburg.

(1). In my paper "On the Chrome-Iron Alloy," inserted in CHEMICAL NEWS, vol. xxxii., p. 136, I promised to communicate the results of some further experiments on the use of chromeisen in the manufacture of steel by the Siemens process.

Experiments proved that, by using chromeisen instead of spiegeleisen, extremely soft steel is obtained; rods made for experiments were very easily bent, even by hand. It is seen, from these attempts to replace spiegeleisen by chromeisen, that the use of the chrome-iron alloys is limited, and the steel obtained is for most purposes too soft for the manufacture of such materials as rails, axles, tyres, &c.

During some experiments with the chrome-iron alloys, a strange phenomenon was observed. It is well known that chromium is extremely hard, and scratches even hardened steel; meanwhile, an alloy was obtained which was malleable, and in a fresh state could be easily bent. It was also remarked that sometimes in opening the crucibles nothing but slag was found, but, in breaking the crucibles, the alloy was found to be in the bottom of them. That may be attributed to the corrosive properties of the liquid alloy, which often penetrated even through the bottoms of plumbago crucibles.

The above-mentioned alloy was analysed, and the following average composition was found:—

| | Per cent. |
|-------------------------|-----------|
| Metallic iron.. .. | 96.40 |
| Metallic chromium | 2.30 |
| Carbon | traces |
| Lime | 1.30 |
| Silica | |
| | 100.00 |

(2). By melting a mixture of cast-iron, tin, and lead in the following proportions, a very liquid alloy is obtained:—

| | Per cent. |
|-----------------|-----------|
| Cast-iron | 79.00 |
| Tin | 19.50 |
| Lead | 1.50 |
| | 100.00 |

The alloy has a very handsome appearance, and fills perfectly well the casting-moulds; thus it could be used for casting small articles. The alloy is to some degree malleable.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 255.)

THE calculations which Helmholtz† has lately put forward concerning the respective ratio of bulk to resistance and to speed in ships and balloons are therefore of great value. According to him the speed of Dupuy's balloon nearly

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† Helmholtz, *Berl. Akad. Ber.*, 1873, 501.

attained the maximum possible for its size. In order to proceed slowly against a fresh breeze, with the sources of mechanical power at present available, the volume of the balloon must be three and a half times larger than that of the largest ship of the line. This demands of the tissue with which the balloon is to be constructed a degree of strength scarcely possible. In fact the expectations of the inventors did not go beyond the hope of steering the balloon when the air is tranquil. If the screws or paddle-wheels are enlarged they must also be made thicker and stronger in order to preserve the necessary firmness. "We can only work sparingly with slowly-moving propellers of large surface, and to produce these of the requisite size without burdening the balloon too much will constitute one of the greatest practical difficulties."

With this sentence Helmholtz concludes his memoir, and the prospects to which he points fall very far short of the enthusiastic prophecies of such as are guided by their wishes rather than by sober scientific considerations.

The problem of steering balloons turns on three conditions—the production of balloons of the lowest specific gravity; the construction of propellers, light, but capable of resistance; and of sources of power at once light and capable of performing a high duty. In how far chemistry has prepared the way towards the fulfilment of the last condition, *e. g.*, by means of aluminium, the future must decide. The first condition she has accomplished ninety years ago, by means of hydrogen, as is now fully recognised.

Upon the consideration of hydrogen and oxygen should follow an account of the industrial applications of water. These, however, are so many-sided—not to say omnipresent—that they escape our reach. The most important will be considered in especial chapters.

The elements oxygen and hydrogen form, however, as is well known, a second compound, peroxide of hydrogen, H_2O_2 , which has latterly begun to acquire a certain industrial importance.

Peroxide of Hydrogen.

In 1818 Thénard caused acids to react upon barium peroxide, and obtained solutions extremely rich in oxygen which they gave up with remarkable ease. He considered them as higher grades of oxidation of the acids employed, but soon perceived their true nature.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 27th, 1875.

Professor G. C. FOSTER, F.R.S., Vice-President, in the Chair.

THE following candidates were elected members of the Society:—Professor Osborne Reynolds, M.A.; Professor H. J. Smith, M.A., LL.D.; Professor R. B. Clifton, M.A., F.R.S.; C. Busk; J. Thomson; J. W. W. Waghorn; W. Esson, M.A., F.R.S.; F. W. Bayly; and Professor R. W. Emerson MacIvor.

Professor GUTHRIE briefly described Dr. Kerr's recent experiments to show that glass, resin, and certain other substances exhibit a depolarising effect when under the influence of powerful electrical tension, and he exhibited the arrangement of apparatus employed in the research. He also showed certain experiments connected with the investigation.

Dr. GUTHRIE then made a communication on "*Stationary Liquid Waves*," in continuation of that which he made to the Society in June last. If water in a cylindrical vessel not less than 9 inches in diameter be agitated by depressing and elevating a flat circular disc on its surface

at the centre, a form of oscillation is set up which the author terms "binodal." He finds that these fundamental undulations in an infinitely deep circular vessel are isochronous with those of a pendulum whose length is equal to the radius of the vessel; and further, a fact which is extremely interesting, that the motions of the pendulum and water keep together throughout their entire paths. An arrangement was exhibited for experimentally demonstrating these facts. To the upper end of a short pendulum with a heavy adjustable bob is attached a cardboard sector, in the plane of vibration of the pendulum. A silk thread attached to the edge of this sector carries a small paraffin disc, which rests at the centre of the surface of the water contained in a cylindrical vessel. The pendulum-length is adjusted until the motion of the disc is isochronous with that of the water when the two are not in contact. Two other forms of motion may be produced in cylindrical vessels, namely (1), by alternately compressing and extending opposite ends of a diameter, as in the motion of a bell (this gives two diametral nodes, at right angles to each other); and (2) by rocking the vessel, which gives a single diametral node. Each of these has its own period of vibration, the last being the slowest. They may be super-imposed on each other, and a rotation of the water, however great, does not interfere with their formation. In rectangular troughs a binodal and a mononodal wave-system may be established. The former is induced by raising and depressing a wooden lath at the middle of the surface, and the latter by tilting. Binodal vibration in a circular trough may be compared with a vibrating pair of triangular laths, and in rectangular troughs to the balancing of two rectangular laths. In this latter case, the nodes are at one-fourth of the trough's length from each end. Some discrepancies are met with when we compare times of vibration in rectangular troughs of various lengths, and these are due to a scraping action which takes place against the sides of the vessel. The result of the experiments on binodal motion in rectangular vessels is to show that the undulations are isochronous with the oscillations

of a pendulum whose length is $\frac{2}{\pi}$ times that of the trough.

The chief points in connection with this subject to which the author referred as still requiring explanation are:—(1). Why are the motions pendular? (2). How is it that, in circular binodal motion, the times are identical with that of a pendulum of the given length? And (3). What is the mathematical connection between the individual motion of each particle and that of the mass.

Mr. LODGE thought that valuable results might be obtained by treating the mass of moving water as a pendulum, with two bobs oscillating about the node. This might be specially useful with small oscillations, when the surface is practically plane.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

JOHN PATTINSON, President, in the Chair.

THE minutes of the last general meeting were read and confirmed. The Committee's report and Treasurer's statement were presented.

PRESIDENT'S ADDRESS.

Gentlemen,—I have to thank you for the great honour you have again conferred upon me in electing me to be your President for the ensuing session.

In making the customary review of the work accomplished by our Society in the past year, it will be found, I think, that this will bear comparison with the work of most of the previous years of our existence as a society, not only as regards the number of papers read, but also as regards the importance and value of these papers.

Mr. John Morrison gave us a very able and interesting

paper on the "Manufacture of Caustic Soda," as carried on especially in the Lancashire works. Mr. Morrison's paper contains many practical details of great interest to the manufacturer, on a subject about which but little had previously been published. It may be mentioned incidentally here, that there has recently appeared in the *Journal of the Society for the Promotion of Scientific Industry*, a very exhaustive treatise on this manufacture, by Mr. George E. Davis,* and which contains a number of elaborate analyses of the materials in various stages of the process. It is strange that the manufacture of caustic soda, although commenced in several works on the Tyne, has never taken root with us and grown as in Lancashire. In many cases it has been abandoned, and at the present time only about 3000 tons per annum are made on the Tyne, whilst upwards of 50,000 tons are made in the Lancashire district. The question naturally suggested itself during the discussion on Mr. Morrison's paper, "Why does this manufacture flourish in Lancashire and decline in this neighbourhood?" The same materials used by the Lancashire makers are accessible to the Tyne makers; we believe the latter are as well skilled and energetic in their business; and we are as near as they are to some, at any rate, of the markets where caustic soda is consumed. It is somewhat humiliating to such of us as are analysts, to have to confess that the answer to this should be that "probably one of the chief reasons is on account of the differences in the tests of the chemists upon which the caustic soda is sold in the two districts." I have alluded to this subject on previous occasions, but I deem it of so much importance, that you must pardon me if I again call your attention to it, for I believe it is in this way that the chemical manufacturers of the Tyne are very heavily handicapped in the race with their competitors on the other side of the island. The same cause, moreover, affects not only the caustic soda trade, but also the larger and more important one soda-ash. Mr. Morrison states that "the Liverpool test usually ranges 1 to 2 per cent beyond the ordinary commercial one." This is notoriously true, and merchants have been known to make a profit by buying ash by the Tyne test and selling it by the Liverpool test. In a recent case which has come under my notice, a sample of caustic soda tested in Liverpool was certified to contain 60 per cent of soda. The identical sample tested most carefully in my laboratory was found to contain only 57.0 per cent! No notice was taken by the Liverpool chemist of the request by the buyer that the sample should be re-examined. I have been in correspondence with most of the Liverpool chemists, and they assure me that the same standard is adopted there as on the Tyne, viz.: that based on the assumption of the old chemists, that pure carbonate of soda contains 59½ per cent of soda; and yet differences of from 1 to 3 per cent are constantly found between the Liverpool and Tyne tests! I need not tell you that the testing for soda is so simple an operation that there need be no difficulty in two chemists agreeing within a quarter of a per cent in their tests. Now, a difference of from 1 to 3 per cent in the test makes a difference of from about 4s. 6d. to about 18s. per ton in the price. This difference in price constitutes a fair profit in itself, and would sometimes enable the Lancashire maker to prosper whilst his Tyne fellow manufacturer would be losing money. I am afraid there are no means of remedying this state of things until the customers of soda-ash and caustic soda are made acquainted with the circumstances, and insist upon being supplied with the percentage of soda for which they pay. How this is to be done I leave the chemical manufacturers of the Tyne, who are chiefly interested, to decide.

Mr. N. Glendinning described at one of our meetings an ingenious apparatus he had devised for the absorption of gases in analysis. By a very simple arrangement the gases are made to pass in very minute bubbles through a

considerable depth of liquid, and thus effective absorption is secured. The apparatus is found to be useful in testing the gases in the Deacon process of bleaching-powder making. With the various kinds of new plant now being constructed in our chemical works, many new forms of apparatus, and short simple modes of testing will be devised, and I hope other members will follow Mr. Glendinning's example, and bring them before the notice of our members.

A very able paper was read by our late president, Dr. Lünge, containing criticisms on certain remarks made by Dr. Angus Smith the Inspector of Alkali Works, on the effect of gases from chemical works on the health of the population in the neighbourhood, given in his report to the Local Government Board for 1873-4. Dr. Lünge, I think, succeeded in showing that, so far as statistics had been collated on this subject, they showed a lower death-rate in towns in the neighbourhood of chemical works than in other towns not so placed. Whether alkali fumes, however, are beneficial to health or not, they are certainly very unpleasant, and I am sure Dr. Lünge will agree with me that, on this account alone, it is desirable to limit their escape from our works to the very lowest possible amount.

A note was read at one of the meetings giving the results of an experiment made by our Secretary, to decide a point raised in a discussion at a previous meeting as to the preservation in blue and white glass bottles of the solution of arsenious acid used in testing bleaching-powder. It was found that the solution kept equally well in both kinds of bottles.

Mr. John Wallace read a paper "On Certain New Forms of Bunsen Burner." Mr. Wallace gave the results of several experiments he had made to determine the best proportions of air and gas to be used, in order to develop the greatest amount of heat. Various forms of burners were shown, devised by Mr. Wallace to attain this object, and also to prevent what is often found to be very troublesome in laboratories—the tendency of the flame to strike down when the gas is turned low. I believe Mr. Wallace has made some further improvements, and purposes favouring us with another paper on this subject.

Denayrouze's apparatus for working among poisonous gases was exhibited in action at one of our meetings. The circumstances under which such an apparatus would be useful, will suggest themselves to the mind of every one acquainted with chemical works, collieries, and other places where irrespirable gases are accumulated.

Lastly, Mr. Thomas Gibb favoured us with a useful paper "On the Manufacture of Spongy Iron." There is very little information published on this subject, and it is a great privilege, not only to this Society, but to the world at large, to have the benefit of Mr. Gibb's great practical experience on this subject.

Passing now from a report of our own progress to that of other bodies dealing with subjects of interest to us as chemists, I have to notice that the Committee appointed last year by the British Association, to report on the methods employed in the estimation of potash and phosphoric acid in commercial products (which Committee was asked for by the Glasgow Philosophical Society and by our own Society) has made a preliminary report from which it appears that the Committee has received a large amount of information from various chemists as to the methods employed, and expects to be able at the next meeting of the Association to recommend some correct and ready methods of analysis whereby exact and concordant results may be obtained. It is to be hoped that this may be the case. Meanwhile Mr. Ogilvie has recently published a very elaborate series of analyses pointing out a number of sources of error in what has hitherto been considered one of the most correct methods of determining the amount of phosphoric acid in manures—the oxalic acid and magnesium process.

The Bill introduced by the Government during the last session of Parliament to prevent the pollution of rivers,

* See CHEMICAL NEWS, vol. xxxii., p. 164 et seq.

after being discussed in the House of Lords, met the fate of the "murdered innocents," and was withdrawn towards the end of the session. In framing the Bill the standards of purity suggested by the Royal Commissioners on this subject were not adopted, and the Government seem disposed to make the measure little more at present than one to prohibit the throwing of solid refuse into streams.

Closely connected with this subject is that of the disposal of the sewage matter of towns. How best to deal with this is still an unsettled question. None of the processes which have hitherto been tried are found to be successful in a pecuniary point of view. It has, however, been proved that by a combined system of irrigation and filtration, or of defecation and filtration, the effluent water from sewage can be made so pure as to be no longer a source of nuisance and at a comparatively small cost. This perhaps is as much as can be expected in dealing with refuse matter which has been diluted with about a thousand times its weight of water. The question naturally arises if the whole system of disposal of valuable manurial refuse by water carriage is not a mistake, and if it would not be better to keep these matters separate from the surface drainage and the washing waters of the house. The present system is, however, convenient and cleanly, and, now that we are used to it, will be difficult to alter.

(To be continued.)

NOTICES OF BOOKS.

Office for Referees, Assessors, and Experts, associated to meet the Requirements of the Acts of the Supreme Court of Judicature, and for the Sale of Food and Drugs Act recently brought into operation; also for the Audit of Accounts, Testing the Accuracy of the Reports of Public Analysts, the Settlement of Disputed Patents, and the Preparation of Models or Drawings.

UNDER this head, we have received a couple of circulars and an explanatory letter. The Associated Office seems to be formed for the convenience of members of the legal profession who may require the aid of experts of any of the classes above-named. Our only questions concerning the Association are, Will it promote the interests of science? And will it raise the status of competent and conscientious chemists, and serve to repress pretenders? If the "Office of Associated Referees" is likely to have this effect, it shall have our heartiest support; but, so far, we are quite unable to form any opinion. The Secretary and Manager of the "Office" are total strangers to us, and, though certain eminent men are said to be associated with the "Office," yet, as their names are not mentioned, we must suspend judgment.

Deutscher Färber Kalender für 1875. Jahrgang 1. Leipzig: G. Weigel.*

THIS work appears under the auspices of the editor of the *Muster-Zeitung*. It consists of two sections, the former of which is simply an ordinary almanac, with columns for the arrival and departure of "wares." We may here mention, for the benefit of readers of foreign works on dyeing, that the German word "waare," though it is the literal translation of the English "ware," has a totally different technical meaning. With us it signifies the drugs and chemicals employed in dyeing; with the Germans it denotes the pieces, yarns, &c., to be dyed.

The second part of the book is a collection of receipts, in which we are compelled to state that we see little which is at once novel and valuable. We are somewhat surprised to find the process for producing an orange on silks by means of nitric acid brought forward in a work of this

class. The receipts for scarlet on woollen cloth are different from those now in use in English dye-houses, and, as far as our experience enables us to judge, certainly not superior. The authors are assuredly mistaken in supposing that scarlets are not often dyed with lac-dye. We find no mention of the use of borax, bicarbonate and silicate of soda, &c., to modify the tone of magenta. Nor have we discovered any notice of the hydrosulphite vat, or of the new colours of Croissant and Bretonnière.

The dyer, at the present day, operates almost as frequently upon mixed goods—say, of wool or worsted, with a cotton warp—as upon pure unmingled materials. As regards this important department, our authors appear to have no instructions to communicate.

It is to be hoped that future issues of the "Färber Kalender" will be richer in matter calculated to further the progress of the tinctorial arts.

CORRESPONDENCE.

THE RIVERS' COMMISSION.

To the Editor of the Chemical News.

SIR,—From the sixth and final Report of the Rivers' Pollution Commission, which has recently been published, it appears that the Commissioners have not availed themselves of the modern improvements in water analysis, but have employed the method of Frankland and Armstrong, which, as is well known, is affected with so high an experimental error as to be perfectly illusory.

The strangest peculiarity in the report is the completeness of the demonstration of the untrustworthiness of the analytical methods employed by the Commissioners. The paper by Frankland and Armstrong, which was read to the Chemical Society in 1868, and which exhibited the experimental error of their process as being many times as great as the quantities to be measured, is re-published by the Commissioners.

Methods like Frankland and Armstrong's have a tendency to yield results in accordance with the expectation of the analyst, rather than with the real composition of the sample. This characteristic (which was not prominently displayed in the paper of 1868) has been brought out in a foot-note on page 505 of the Report. I quote from this foot-note.

"Since the above was written several improvements have been made in the process. The following test experiments show that it has now (1874) attained a still greater degree of accuracy, a statement which is further corroborated by the results of very numerous series of analyses of water supplied to London, given in the diagrams facing pages 261 and 262 of this Report. To 100,000 parts of a sample of water, rendered as nearly chemically pure as possible, 1.957 part of sulphate of quinine was added. The following data compare the quantities of organic carbon and organic nitrogen thus actually added to the water with those afterwards found in the two analyses:—

| | Actually Present. | Found by Analysis. | |
|---|----------------------|-----------------------|--------------|
| | | I. Part. | II. Part. |
| Organic carbon in 100,000 parts of water | 0.857 | 0.9120 | 0.904 |
| Organic nitrogen in 100,000 parts of water | 0.100 | 0.0996 | 0.098 |

"In another instance, 0.9785 part of sulphate of quinine was dissolved in 100,000 parts of water, and 0.050 part of nitrogen calculated, and 0.047, 0.048, and 0.048 found; and in a third instance 0.09785 part of sulphate of quinine taken, calculated to contain 0.005 part of nitrogen, the results of experiment being 0.006 and 0.005."

Now, by a happy mischance, Dr. Frankland's calcula

* German Dyer's Almanac.

tions of the nitrogen are miscalculations, and in the above he has afforded us an opportunity of learning by actual trial whether the result accords with the anticipation of the analyst, or with the composition of the sample.

If the reader will take the trouble to calculate the nitrogen contained by 1.957 parts of sulphate of quinine he will find it to be 0.1469, and not 0.100, as Dr. Frankland represents it. In 0.9785 part of sulphate of quinine the nitrogen is 0.0734, and in 0.09785 the nitrogen is 0.0073.

Thus we see that when 0.1469 nitrogen was really present, and when 0.100 nitrogen was supposed by Dr. Frankland to be present, his analysis exhibited a close approximation to 0.100, and similarly in the two other cases.

It would be hard to imagine a more striking exemplification of the utter worthlessness of an analytical method, and the Royal Commissioners are to be congratulated on having furnished us with it.—I am, &c..

J. ALFRED WANKLYN.

November 27, 1875.

DISEASED MILK.

To the Editor of the Chemical News.

SIR,—Mr. Blyth's paper on the milk of cows suffering from foot and mouth disease cannot fail to interest not only Public Analysts, but also the consumers of milk generally. The fact that children, and even adults, suffer from analogous ailments, which may be traced to the consumption of milk drawn from cows attacked by this disease, is every day pressing more and more upon our notice.

Through the indefatigable zeal displayed by the Medical Officer of Health for this town in thoroughly sifting this matter, I have had occasion to examine no less than one hundred and twenty-seven samples of milk from cows suffering from the "foot and mouth disease" during the past six months.

Mr. Blyth gives the *post mortem* appearances of a calf which died with extreme suddenness after suckling its mother. These suggest that the animal was already suffering from the disease itself, otherwise the apthous patches would not be present.

I have found, almost invariably, that the milk of the cow, even on the first day of the attack, differs from healthy milk; and the various appearances characteristic of this disease are often observable on the first or second day, and not unfrequently remain for fourteen or twenty-one days. The tendency of the milk globules to aggregate, as the author remarks, is one of the principal signs of this disease, and one which is never absent. This disposition of the fat globules to aggregate is, in my opinion, due to the casein being in a modified form. The fat globules are much larger than in healthy milk, and during the advanced stage of the disease rise to the surface not as cream, but almost pure butter fat. The film which envelops the particles of fat presents a glairy, mucous-like appearance, and is intensely refractive.

The affinity of this matter to envelop and retain the particles of fat equally distributed throughout the milk is so weak that it is only necessary to agitate a strongly affected sample for a few minutes to enable one to obtain, from a pint of milk, a lump of butter weighing an ounce or more. The casein, under these conditions, remains unaltered, and in many instances is with difficulty coagulated by dilute acids.

Pus cells, granular cells, epithelium, and animal matters are observed more or less throughout the continuance of the attack, but are present in larger quantity during the full development of the disease. I have been unable, with any degree of certainty, to detect either bacteria or vibriones, and I am inclined to think that the bodies somewhat resembling these are altered fat globules or animal matters.

With regard to the composition of the milk of cows suffering from this disease, the result of my experiments differ entirely from those of Mr. Blyth.

Immediately the animal is attacked the secretion

becomes less in quantity, and when the milk glands are seriously affected so acute is the action of the accompanying fever that apparently a portion of the normal water of milk is retained, and we find, in consequence, 20 or 25 per cent of solids containing as much as 10 per cent of fat. Moreover, the proportion of casein to lactin is augmented rather than diminished. It is true, however, that milk drawn from animals seriously affected is almost always strongly acid, and a portion of the lactin may have been lost by acid fermentation. This was not the case with the samples, the analyses of which are given below. In many instances the milk secretion does not appear to be affected to any considerable extent, and the composition of the milk does not strikingly differ from that of healthy milk.

I have found, almost without exception, that the proportion of fat in diseased milk is as great, and often much greater, than in healthy milk.

I am indebted to Mr. Moir, M.R.C.V.S., for samples obtained by himself direct from the cows, and his observations entirely accord with mine.

The following analyses are selected from a great number, and will show the composition of the milk according to the state of the disease:—

A. Third day of duration; virulently attacked.

B. Fifth " " " "

C. Fourth " " strongly "

D. Fifth " " " "

E. Third " " slightly "

F. Sixth " " " "

| | | Water. | Fat. | Casein. | Lactin. | Ash. | Total Solids. |
|--------|----|--------|------|---------|---------|------|---------------|
| A. . . | .. | 76.40 | 9.91 | 8.01 | 4.69 | 0.99 | 23.60 |
| B. . . | .. | 78.38 | 8.26 | 8.22 | 4.25 | 0.89 | 21.62 |
| C. . . | .. | 81.80 | 7.01 | 5.92 | 4.47 | 0.80 | 18.20 |
| D. . . | .. | 82.39 | 4.60 | 6.00 | 6.20 | 0.81 | 17.61 |
| E. . . | .. | 84.04 | 3.86 | 5.43 | 5.94 | 0.73 | 15.96 |
| F. . . | .. | 86.87 | 4.01 | 4.03 | 4.39 | 0.70 | 13.13 |

In some few instances, where the animals were certified as suffering from a severe chill in addition to the disease, the milk was very poor, the fat falling to 2 per cent, and the casein and lactin $3\frac{1}{2}$ and 5 per cent respectively. I find the ash low in all instances when compared with the total solids.

The composition of diseased milk differs greatly, and the more the udder participates in the disease, or is affected by it, the larger will be the percentage of solids present in the milk.

J. W. THOMAS.

Cardiff, November 23, 1875.

REFORM IN THE MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—The above "sensational heading" led one to hope that it was all coming at once—that some lucky fellow had indeed hit upon the one method for profitably extracting this important article from the atmosphere. But, alas! no such luck, for the letters of "Onward" admit of no reply so fitting as the first four lines from E.H. (CHEMICAL NEWS, vol. xxxii., p. 204), implying that "Onward" ought to "move on," or, in other words, reform at home first. Or, in view of "Onward's" last letter, one might reasonably expect that in his next letter the name and address of the "large party" would appear as the only maker of sulphate of ammonia, and that the now familiar cognomen of "Onward" would be changed into "Advt."

Be this as it may. "Onward" says white sulphate of ammonia cannot be made from pyrites acid. I can tell him, as a fact, that sulphate (I use the word advisedly) of ammonia—perfectly white and free from sulphocyanides—can be made, and has for years been made (since 1857 by myself), from sulphuric acid manufactured from various kinds

of sulphur ore, and is now daily made from Spanish pyrites acid.

It will be readily admitted that having obtained white sulphate containing the 24 per cent, a little careful manipulation will produce a "good grey," or an "orthodox hue," or a "brownish tint," or "black as my hat," as your correspondent, "Mid-day," has it. Although I daily make white sulphate, I quite agree with the last paragraph of "Mid-day's" letter as practical and to the point. I have never tried the "white sand" experiment. I wonder if arsenic is precipitated by sand? There may be some intelligent practical chemists who would be curious to learn what methods of "analyses for ammonia" was employed to detect the large quantity of this certainly strange material in this "good grey," which was so "unexceptionable in appearance." Perhaps it was really a "sand glass."—I am, &c.,

G. J. S.

CHEMICAL NOMENCLATURE.

To the Editor of the Chemical News.

SIR,—If the cause assigned by "Amateur" to the dearth of chemical students in this country be true, it remains for us only to weep over the little souls that can be dismayed by an array of words, and admire, while we envy, the superior courage of the youth of other lands who are not so easily daunted. This is the more to their credit as the mysterious horrors of such "crack-jaw words" are greatly enhanced by the necessity of pronouncing them with the "accent." But this is absurd. "Amateur" speaks of "would-be students" taking up a book, and finding in it such words as "polymerism," "paramido-ortho-sulphotoluolic acid," &c., relinquishing the pursuit of the science on which that work is a treatise. In the first place, I do not think that organic chemistry is the first pabulum offered to the mental palate of the neophyte.

On the contrary, every effort is made to prepare him for the shock. His nerves are strengthened by gentle instalments of Science Primers and Pepper's Playbooks. He is then introduced, warily and discreetly, to some more advanced inorganic volume. When this (in which already poly-syllabic words begin to loom) is duly digested, such a work as Armstrong's "Organic Chemistry," perhaps, is playfully brought under his notice, and thus he launches, well prepared, into the sea of C's and H's, amidos and paranidos, orthos and metas, and isos, which seem to produce so great an impression on "Amateur." Organic chemistry is not intended for a novice. There would be as much sense in a "would-be" student of harmony declining to undertake the pursuit of that melodious science because he lighted on some such word as semi-demi-semi-quaver; or in an embryo mathematician relinquishing his studies because he saw in an Euclid "semiparallelpipiped" (I also quote at random), as in the case mentioned by "Amateur." I do certainly not think that the paucity of chemical disciples is to be sought for in that direction.

With regard to a work on organic chemistry where a good classification may be found, I do not think "Amateur" can do better than consult the Text-Book of Science, "Organic Chemistry," by Dr. Armstrong, or the little "Manual of Chemistry," by Fownes. A new edition of Miller's "Organic Chemistry" will shortly appear, and it would be hard if, in one of these works at least, "Amateur" did not find what he wants.—I am, &c.,

C. LEOPOLD FIELD.

Hither Green Lodge, Lewisham.

CHEMISTRY IN SWANSEA.

To the Editor of the Chemical News.

SIR,—Perhaps you will allow me to make a few remarks upon your article (CHEM. NEWS, vol. xxxii., p. 251) entitled as above.

1. A certain portion, but not the most influential, of the local press has—for reasons of its own—lost no opportunity of speaking disparagingly of Mr. Morgan, and the post he fills.

2. Mr. Morgan, while giving his evidence in the "oil trial," got so thoroughly nervous and utterly confused that he had but rather a dim idea of what he was talking about. Consequently his answers were very different to those he would have given in calmer moments.

3. The sight of the Public Analyst in a witness-box, and thoroughly bewildered, was a most pleasing spectacle to certain disinterested friends of his, who thought it a rare opportunity for making him say what nonsense they chose, in the most grotesque manner possible.

4. Mr. Morgan denies that he used the term "mineral oil" in the evidence he gave.

5. Other gentlemen, who were present in the Court at the time, also emphatically deny Mr. Morgan used the above words. Some of these gentlemen are public men of position in the town.

It seems to me, therefore, that there are two sides to this, like every other question, and that Mr. Morgan has been very hardly dealt with. Allowing the version of the evidence which has gone the round of the press to be a correct one—are they not "hard lines" which condemn a man unfit for his post just because in a fit of bewilderment he made a statement which was absurd?

Notwithstanding all that has been made of this unfortunate affair, most people still think the Public Analyst for Swansea is fully competent to perform the duties of his office.—I am, &c.,

J. L. DAVIES.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 19, November 8, 1875.

Memoir on the Measure of Affinities in the Mutual Reactions of Two Solutions, taking the Electromotor Forces as Bases.—M. Becquerel.—The author recapitulates the conditions necessary for the production of electrocapillary currents, and the chemical actions to which they give rise. After describing certain experiments, he announces his intention of giving the results of experiments made to determine the values of the affinities, in virtue of which the liquids of organised bodies react upon each other so as to maintain life in all their component parts.

Alcohols which Accompany Vinic Alcohol.—M. I. Pierre.—The author points out the injurious effects of the propylic, butylic, and amylic alcohols.

Exhaustion of the Soil by Apple Trees.—M. I. Pierre.—The author calculates that in a life of sixty years an apple tree removes from the soil 26 kilos. of nitrogen, equal to 5200 kilos. of farm-yard dung. To maintain the soil in condition, therefore, about 80 kilos. of dung ought to be annually given per tree during the fifty years that it is in bearing.

Observations on the Foregoing Paper by M. P. Thénard.—The author calls in question the views of M. Pierre.

Separation of Mixed Liquids, and on New Maximum and Minimum Thermometers.—M. E. Duclaux.—This memoir treats of the conditions governing the separation of a homogeneous mixture of two liquids into two layers when any external circumstance—e.g., a fall of temperature—intervenes to disturb the solution, and transform it into a double mixture. In these conditions the composition of the two layers which are formed remains

constant whatever may be the initial composition of the liquid, only varying in their relative volume. The same fact occurs in ternary mixtures when—which often happens—one of the constituent liquids does not take part in the separation, and remains in the same degree of concentration in each of the two layers produced, as in the primitive liquid. The only new phenomenon is that the presence of this third liquid modifies the molecular relations of the two former, rendering them, for instance, soluble the one in the other, serving them for a tie of union, and thus permitting them to manifest the same phenomena as above. They distribute themselves, when the original equilibrium is destroyed, into two layers of almost constant composition, among which the third liquid is uniformly divided. From this constancy of composition it follows that it is always possible to set out from an initial mixture, such that, under the action of a fall of temperature, it is divided into two strata of the same volume; and experience shows that the variation of temperature necessary for obtaining a phenomenon so well characterised is extremely small—much less than one-tenth of a degree. For instance:—A mixture of 15 c.c. of amylic alcohol, 20 c.c. of common alcohol, and 32.9 c.c. of water, forms, at 20°, a very unstable molecular group, which on the least fall of temperature is resolved into two strata almost equal. Traces of common salt, of chloride of calcium, of various other soluble salts, and of vapours of chloroform, produce the same effect. The same result is obtained on adding a drop of water, or of amylic alcohol, which do not enter into solution because the mixture of the two liquids is saturated. This leads to the construction of a very simple maximum and minimum thermometer. The mixture given above, limpid and homogeneous above 20°, becomes turbid at this temperature, and is divided into two equal layers. Other mixtures, with more or less water, exhibit the same phenomenon at other temperatures. These instruments have the inconvenience of requiring a special mixture for every temperature; but they are easy to construct, economical, solid, and dread neither shocks nor the influence of pressure.

Process for Separating Cholesterin from Fatty Matters.—M. A. Commaille.—The author saponifies with caustic soda, and after cooling and dissolving the soapy mass in water he agitates with ether. This liquid, when separated and evaporated, yields numerous flakes of cholesterin.

Determination of Caffeine, and on its Solubility.—M. A. Commaille.—The author operates upon 5 grms. of powdered coffee, passed through a sieve of silk, No. 60. The powder is intimately mixed with 1 grm. calcined magnesia. With this mixture he forms a paste, almost solid, which is left for twenty-four hours, when it becomes yellow, and then green in contact with the air. It is spread then upon a saucer placed upon boiling water. In a little time we have a solid mass, which is triturated and sifted. This green powder is placed in a small balloon and treated, as Lieventhal directs, three times with anhydrous chloroform (100 grms. in three applications suffice for the exhaustion). It is boiled each time for half-an-hour, by plunging the flask into hot water. The chloroform flows back into the flask by using a Liebig's condenser filled with water. The filtration of the cold chloroform is very rapid. The liquid, perfectly colourless, is received in a flask having a neck of the same diameter as that which has been used in refrigerating, in order that it may easily fit the stopper of the refrigerator. The chloroform is then distilled off. When the chloroform is evaporated there remains a substance almost colourless and very bulky, consisting of fatty and waxy matters, and of caffeine. Water is poured in along with 10 grms. of broken glass, previously washed in hydrochloric acid, and reduced to a powder as fine as what is used for drying up ink. The mixture is heated, with constant stirring. When the water boils the flask is closed with linen, and is well shaken. The liquid is then thrown upon a moistened filter,

and received in a tared capsule. By repeating this process three times all the caffeine is taken up, and on evaporation is found white and crystalline, and may be weighed when perfectly dry. 100 grms. of the liquids below dissolve—

| | At 15° to 17°. | At 100°. |
|---------------------------|----------------|----------|
| Chloroform | 12.9700 | 19.020 |
| Alcohol (85°) | 2.3000 | — |
| Water | 1.3500 | 45.550 |
| Pure alcohol | 0.6100 | 3.120 |
| Ether (common) | 0.1900 | — |
| Carbon bisulphide | 0.0585 | 0.454 |
| Anhydrous ether | 0.0437 | 0.360 |
| Petroleum essence | 0.0250 | — |

Researches on the Inversion of Cane-Sugar by Acids and Salts.—M. G. Fleury.—The author has studied the progress of inversion produced by different acids employed in equivalent weights. He gives tables representing the percentages of sugar transformed in equal periods of time. There is no apparent relation between the speed of inversion and the atomic weights of the bodies which produce it: thus arsenic acid acts more rapidly than phosphoric acid. If different proportions of sugar are employed with the same acid, the time required for its complete inversion is constant, and that within narrow limits. If the dose of acid is varied the duration of the phenomenon is abridged as the weight increases. Experiment shows that glucose and levulose—products of the decomposition of cane-sugar—have no tendency to recombine, at least in presence of the acid which has determined their separation.

Comparison of the Unipolar Excitations of the same kind; Influence of the Increase of the Current of the Battery upon the Value of these Excitations.—M. A. Chauveu.—Not adapted for abstraction.

Central-Blatt für Agrikultur Chemie,
Heft 9, September, 1875.

Researches on the Ripening of Grapes.—Cerletti.

Process of Germination, and on the Presence of Crystalline Sugar in Sprouting Cereals.—Gotthold Kühnemann.—From *Ber. der Deutsch. Chem. Gesell.*, 1875, No. 4, p. 202.

Experiments on the Transformation of Asparagin in Plants.—M. Mercadante.—From *Ber. der Deutsch. Chem. Gesell.*, 1875, No. 11, p. 823.

Crude Fibre of the Gramineæ.—A. Stutzer.—See *Ber. der Deutsch. Chem. Gesell.*, 1875, No. 8, p. 575.

Constitution of Poplar and Pine Wood.—F. Beute.—*Ber. der Deutsch. Chem. Gesell.*, 1875, No. 7, p. 476.

Evolution of Hydrogen, and the Formation of Ammonia by Fungi.—F. Selmi, G. B. Ercolani, F. Sestini, and G. Del Torre.—The larger fungi evolve hydrogen as well as the mould-plants, and chiefly on the side turned away from the light. A small quantity of it combines with the nitrogen of the air to form ammonia, especially in places where there is no free circulation of air.

Researches on the Vital Process of Fungi.—M. Muntz.—From *Comptes Rendus*, 1875, No. 3, p. 178.

Comparative Merits of the Varieties of Maize.—Prof. G. Wilhelm and A. Mell.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 8, October 21, 1875.

The Academy of Sciences of St. Petersburg has published a chronological *resumé* of its *Transactions* for the years 1873 and 1874.

The French Association for the Advancement of Science has concluded its fifth meeting at Nantes.

No. 9, October 28, 1875.

In this issue we find the discourse delivered by M. Dumas on the death of Sir Charles Wheatstone.

No. 10, November 4, 1874.

Waterproof Tissues and Paper.—Bichromate of potassa has the property of rendering glue and gelatine insoluble in water. Thus paper, and stuffs of cotton, linen, or silk, if once coated with this insoluble glue, become perfectly impervious. To render glue insoluble it is sufficient to add to the water in which it is dissolved 1 part of bichromate to 50 parts of gelatine. The addition is only made at the moment when the liquid is to be used. The process is conducted in full daylight. The Japanese make their umbrellas with paper prepared in this manner.

M. Reimann's Farber Zeitung, No 41, 1875.

The patent colours of Croissant and Bretonnière are offered by a new establishment under the name "sulfin colours."

No. 42, 1875.

In this issue is a scheme for dyeing plush-black with white tips, by brushing over with a reserve made of stearine and resin melted together. After this composition has hardened, the plush is dyed in the cold, and the reserve paste subsequently removed in a soap-beck at 50° R.

There are receipts for silk and jute dyeing which present no remarkable feature.

MISCELLANEOUS.

The Royal Society.—Tuesday, being St. Andrew's Day, the anniversary meeting of the Royal Society, as required by their charter, was held. The President, Dr. Hooker, began his address with a few remarks on the large number of eminent Fellows whose names appeared in the death-list of the past year, and then gave a summary of the numerous measures for "the improvement of natural knowledge" undertaken by the Society. These comprise the publication of papers in the *Philosophical Transactions* in a separate form; preparation of additional volumes of the "Catalogue of Scientific Papers;" the labours of committees in connection with the Transit of Venus Expedition, and the researches of naturalists in Kerguelen and Rodriguez; the Eclipse of the Sun Expedition to Siam, the Polar Expedition, the voyage of the *Challenger*, and of the committee appointed to consider the suggested modification of the regulations under which candidates are elected into the Society. The auditors' report showed that the pecuniary resources of the Society were in a satisfactory condition, and Dr. Hooker mentioned the bequests made to the Society by the late Sir C. Wheatstone and Mr. H. Dircks. The medals were then presented—the Copley medal to Dr. Hofmann, a Royal medal to Mr. Crookes, and a Royal medal to Dr. Oldham (at present in India), through Professor Ramsay. The proceedings terminated with the election of Council and officers. For the ensuing year, the following gentlemen were elected:—

President—Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D.

Treasurer—William Spottiswoode, M.A., LL.D.

Secretaries—Professor George Gabriel Stokes, M.A., D.C.L., LL.D.; Professor Thomas Henry Huxley, LL.D.

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The Anniversary Dinner was held at Willis's Rooms, Dr. Hooker in the chair, supported by the Marquis of Salisbury, Lord Cardwell, Mr. W. H. Smith (of the Treasury), the Right Hon. Robert Lowe, Mr. Farrer, Admiral R. Hall, Mr. Lyon Playfair, the City Chamberlain, Mr. W. Spottiswoode (Treasurer R.S.), Professors Stokes and Huxley (Secretaries R.S.), Sir Charles Shadwell, Admiral Richards, Capt. Evans, Hydrographer-General Strachey, Sir J. Grant, Sir B. C. Brodie, Dr. Hofmann, Mr. Crookes, Professor Ramsay, Sir A. Armstrong, and a large number of the Fellows of the Society and their friends.—*The Times*.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 6th.—Medical, 8.

Society of Arts, 8. Cantor Lectures: "On the Discoveries and Philosophy of Liebig, with Special Reference to their Influence upon the Advancement of Arts, Manufactures, and Commerce," by Dr. Thudichum.

TUESDAY, 7th.—Civil Engineers, 8.

Zoological, 8.30.

WEDNESDAY, 8th.—Society of Arts, 8. "On the Mode of Levying the Sugar Duties in France, and its Influence on the Sugar Industries of Great Britain," by Prof. Leone Levi, F.S.S., &c.

THURSDAY, 9th.—Royal, 8.30.

Royal Society Club, 6.30.

FRIDAY, 10th.—Astronomical 8.

Quekett Club, 8.

Anthropological Institute, 8.

Society of Arts, 8. Special Lectures: "Industrial Pathology, or the Influence of Certain Injurious Occupations on Health and Life," by Dr. B. W. Richardson, M.D., F.R.S. (Lecture II.)

SATURDAY, 11th.—Physical, 3.

TO CORRESPONDENTS.

Fair Play.—We have heard from Mr. Morgan privately, and shall probably refer to his case in our next issue. Mr. Morgan's cause would profit little if left to your advocacy. Invective is not explanation.

"Beet" and "Cane."—It is unnecessary to publish your letters. Mr. Stewart has admitted the charge of plagiarism, and we can devote no more space to the subject.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums, received since the 23rd instant:—

Previously acknowledged, £345 4s.

| | | | |
|------------------------|--------|----------------------|--------|
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The Committee will gladly receive further contributions, which the Treasurer will acknowledge by post.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 837.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;

Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 265).

It may be interesting to know that the approximative yield of the several products per 1000 gallons of coal-tar is as follows:—

Crude and light oil, sp. gr. 0.940 to 0.970 from 24 to 40 gals.
Creosote oil , 1.060 , 1.070 , 120 , 180 ,
Anthracen oil , 1.080 , 1.095 , 100 , 160 ,
Pitch which melts at 176° F. 3.2 to 3.6 tons.

These products are again submitted to further operations for the purpose of getting benzol, toluol, light burning and solvent naphthas, carbolic and cresylic acids, creosote for fuel and for timber, and anthracen; but the processes are not generally offensive, and therefore need not engage much of our attention, although a brief outline of them may be useful. The light oil is re-distilled from stills with steam jackets or with closed coils, or by blowing steam into it. That which flows up to a gravity of 0.940 is put aside for benzol and solvent naphtha, and the remainder is used for carbolic acid. The naphtha thus obtained is purified by treating it with strong sulphuric acid, after which it is washed with lime water, and distilled for benzol and solvent naphtha. The heavier naphtha and the first runnings of creosote are washed with a solution of caustic soda for carbolic acid, which is subsequently separated from the alkali by neutralisation with acid; and the green anthracen oil is allowed to stand until quite cold, when the crude anthracen separates from it in granular particles. These are strained off through canvas bags and pressed in hydraulic or screw presses, whereby the crude anthracen of commerce is obtained. The approximative yield of each of these several products is:—

| | |
|-------------------|--------------------------------------|
| From crude | { 6 to 10 per cent tar acid. |
| naphtha and | { 20 , 28 , benzol. |
| light oil from .. | { 10 , 15 , solvent naphtha. |
| Creosote oil .. | { 10 , 15 , carbolic acid, &c. |
| Anthracen oil .. | { 10 , 12 , crude pressed anthracen. |

For the purpose of increasing the yield of anthracen with a large admixture of chrysen the distillation of the pitch is sometimes carried on until a spongy coke remains in the still, and under these circumstances the acidity of the evolved vapours is most offensive, and requires the utmost attention to prevent their becoming a nuisance to the neighbourhood. The main points, therefore, to be observed in the conduct of works of this description are:—

1. The transport and storage of the coal-tar in air-tight tanks or vessels guarded with boxes containing hydrated oxide of iron.

2. The proper construction of the primary receiver of the products of distillation, so that it may freely deliver them by special pipes to their respective receivers, and at

the same time convey offensive non-condensable products to the scrubbers and purifiers.

3. The passage of the offensive non-condensable gases and vapours to a scrubber charged with a douche of cold water, then to an oxide of iron purifier, and thence to a tall chimney shaft.

4. The proper cooling of the pitch in air-tight vessels before it is allowed to reach the external atmosphere, and the ventilation of these vessels through the scrubber and purifier before mentioned.

5. The use of a fan or other exhausting power, so as to draw all the noxious gases and vapours from the stills, the pipes, the receiver, and the pitch den into and through the scrubber and purifier before mentioned.

The production of paraffin oil from cannel coal, and the distillation of the crude tar, as well as the distillation of petroleum and Rangoon oil, requires like precautions, though not to the same extent, as the products are not nearly so offensive as in the case of coal-tar products.

Dead oil or creosote is largely employed for preserving timber; but unless there is great carelessness in the management of the operations they are not offensive. The process is conducted in the following manner:—The timber to be creosoted is placed in iron cylinders of great strength and capacity; and when the end opening is closed and well secured with screws, the interior of the cylinder is exhausted by means of an air pump until there is a vacuum of about 5 inches of mercury. This is maintained for nearly half an hour, during which time the contents of the cylinder are heated by steam pipes. In this manner the air and moisture of the wood are drawn out of it, when dead oil is allowed to run into the cylinder until it is full. The heat is continued, and pressure is put upon the contents of the cylinder until it reaches to from 100 to 150 lbs. upon the square inch. This is maintained for many hours—the time varying from four to twelve hours, according to the nature of the work; in most cases the amount of creosote absorbed by the wood ranges from 40 to 50 gallons to the load of 50 cubic feet. The oil is then run out, and when sufficiently drained the timber is ready for delivery. Hardly any precaution is necessary beyond that of preventing the unnecessary escape of creosote oil and vapour.

Dead oil is also used as fuel, and there are two ways in which it has been successfully employed. In one case the oil is converted into vapour in a specially contrived boiler, and the vapour is burnt as fuel. In the other the creosote is delivered from a jet immediately over a steam jet, and as the creosote trickles down from the upper jet it meets the blast of steam which blows it as a fine spray upon a bed of glowing cinders or ashes. In this manner it produces a sheet of flame of great heating power. A ton of creosote, which is about 210 gallons, is equal to about 2 tons of ordinary coals; but the management of the jet or stream of creosote is rather a delicate operation, as an excess of the oil produces an immense volume of smoke, with the acrid irritating odour of the unburnt oil.

Before leaving the subject of these hydrocarbons, I may state that the *melting of pitch and asphalte* for the production of materials suited for the making of asphalte pavements, &c., is in the generality of cases a very offensive operation. All sorts of pitchy matters, as the residuum of paraffin oil (technically called "shellgrease"), Trinidad bitumen, various natural asphaltes, and coal-tar pitch are melted in small iron boilers set over naked fires. The boilers are but loosely covered, and during the melting and mixing, to produce the material called "bitumen," large volumes of irritating and offensive vapours escape into the air. The bitumen thus produced is, in some cases, again heated with powdered asphalte in specially constructed boilers having a mixer moved by machinery; and in this case offensive vapours are freely evolved. The charge when thoroughly incorporated and melted is called "mastick," and is drawn off into pails, and cast in moulds for use where the pavement is to be laid. All these operations should be conducted in closed

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

boilers, which should be ventilated by a fan through a scrubber prior to its entrance into the chimney shaft.

The clarification of oil for burning and other purposes is generally effected by means of sulphuric acid, which is well stirred into it. After the black flocculi, formed by the action of sulphuric acid upon impurities, have subsided, the oil is further clarified by means of water and steam, the latter being blown into it until it reaches a rather high temperature; and during this part of the operation the oil is kept in gentle agitation by means of stirrers so as to favour the separation of the oil from water and other impurities. In the case of rape or colza oil, the vapours which are given off are disagreeable and acrid, like mustard, while those of linseed and other oils are also offensive though in a less degree. Cotton oil is refined by means of a solution of caustic soda, and this also, when subsequently heated by steam, is offensive. The remedy in each case is the carrying on of the operations in closed vessels, ventilated to the furnace fire.

The distillation of oils and fats for the production of stearic, margaric, palmitic, oleic, and other fatty acids is effected by means of sulphuric acid and superheated steam. The melted fat is run into vats or boilers, where it is heated to a temperature of about 240° F. At this temperature it receives a dose or charge of strong sulphuric acid, delivered into it as a fine spray, or through perforated copper trays. All this time it is kept in continual agitation by means of stirrers, and this is prolonged for about an hour, during which time a little sulphurous acid and acrolein escape. When the fat acquires a dirty greenish tint the "saponification," as it is called, is complete. Boiling water is then run into the mixture and steam blown through it for about four hours; after this it settles for a couple of hours, and the acid watery portion is run off. It is washed a second time with hot water and steam, and when clear it is delivered into the stills for treatment with high pressure superheated steam—the pressure being about 50 lbs. on the inch, and the temperature about 500° F. At this temperature and pressure the fatty acids are distilled over, and are collected in a series of condensers, ending in a worm set in cold water. The first condenser delivers the greater part of the fatty acids with but little water, the second more water and less acid, and so on to the end, where water is the chief product. The water contains glycerin, and the residuum in the stills is a sort of pitch, which is used by the asphalt makers.

In these operations sulphurous acid and acrolein are evolved, so as to be offensive to the neighbourhood, unless they are conveyed from air-tight apparatus into the furnace fire.

Oil boiling for making varnishes, linoleum, leather-cloth, printer's ink, and black japan, is a very disagreeable operation, and requires to be conducted in boilers, from which the fumes pass into the furnace fire to be destroyed.

Varnish making and rosin distilling are also offensive operations, and necessitate the destruction of the acrid organic vapours by carrying them to the furnace fire, or to fires placed at the outlet of hoods which cover the pans. In cases where inflammable spirit is used to a large extent in certain manufactures, as in making American cloth, the difficulty of dealing with the vapour is exceedingly great, as it is dangerous to pass it through a furnace fire for fear of explosions. In one factory with which I am acquainted, the quantity of petroleum spirit used daily in the thinning of the oil for the colours is not less than 140 gallons—all of which is daily evaporated from the cloth in the drying room, which is gradually raised to a temperature of 130° F., at which it is kept for six hours during the drying of the colours. In these cases it is best to ventilate the room freely by special shafts communicating with the chimney at a point where the vapours are not likely to be fired.

Fat melting, bone boiling, tripe dressing, and the cooking of sheep's heads, bullocks' cheeks, livers, and feet, as well as the boiling of shell fish, lobsters, and crabs, are all

offensive operations, and require to be conducted in closed coppers ventilated by special flues, which carry the organic vapours into the fires beneath them.

(To be continued)

NOTES ON A VISIT TO CHEMICAL WORKS IN FRANCE IN THE SUMMER OF 1875.*

By R. C. CLAPHAM, F.C.S.

DURING the past summer I had occasion to pay a visit to France, and I took the opportunity of making enquiries about, and personally visiting some of the large industrial works there. To-night I propose to read to the members a few short notes, mostly made on the spot, specially referring to the soda manufacture in France. This industry is interesting to us in this locality from various points of view. It is to France that we are indebted for the process now universally adopted for making soda in England, and for Gay-Lussac's important invention for saving nitrate of soda, and for many other chemical inventions of great practical utility. In a paper read before the members in 1867, I stated that not many years passed away after the establishment of the first soda works in Paris, in 1794, before our own townsman, the late Mr. William Losh, commenced soda works on the Tyne; this district being, in fact, the cradle of the soda manufacture in England.

The chief points of interest I was desirous of directing my attention to were—the difference in the arrangement and construction of "plant" in the two countries; the quality and cost of the raw materials employed in the manufacture; the technical results obtained in the different departments; and the organisation of the French workmen, and the wages paid. To some extent, all these necessarily vary in different parts of France, but the main features may be given.

There appears to be no published statistics in France relating to the consumption of materials in chemical works or the products therefrom. Perhaps one of the best tests as to the extent to which the soda manufacture is conducted in any locality is the consumption of salt, and I took some pains to ascertain this in France; and, as far as I could learn, the total consumption of salt for chemical purposes did not exceed 120,000 tons per annum. Part of this is employed simply in making sulphate of soda for glass works, and the rest in making soda. When we recollect that the salt used on the Tyne alone amounts to about 190,000 tons annually, the quantity used in France appears very small; this is partly accounted for from the fact of France being an importer of chemicals from England, and also that, owing to her bright and clear atmosphere and her sunny skies, the use of chemicals, in which soda occupies a part, are not so much required.

Chemical works are situated in different parts of France—at Rouen, Lille, Channy, Alais, Marseilles, and other places. Some of these works are very extensive, and one which I visited used as much as 23,000 tons of salt per annum. The supply of raw materials is obtained from various sources—pyrites are chiefly obtained in France itself and from Belgium, and the cost at some of the works is 47s. per ton, as compared to 26s. in England; coals are obtained in large quantities from Pas-de-Calais, also from Belgium, and certain classes of coals from the Tyne and Cardiff, and they cost about 22 to 28 francs per ton (the French coal is not at all bad for firing purposes, but contains a good deal of ash); salt costs about 28 francs per ton, the Belgium ground rock-salt, which is at present being imported there, being rather less; manganese of 70 per cent costs as much as £8 10s. per ton; but the supply of limestone is both abundant and cheap. It will be seen, therefore, from the above prices, that the raw materials in France are

* A Paper read before the Newcastle Chemical Society, November 25, 1875.

considerably dearer than in England. This partly arises from the position of the works and from other causes, but still the fact remains the same. On the other hand, wages of workmen are all much lower than in this country, but at the same time the work turned out by each man is less. It may, however, be safely stated that the daily wages of workmen in France for this class of work are 20 to 30 per cent lower than with us. As far as I could myself judge from seeing them at work, and also from visiting their houses, which I had the opportunity of doing, the workmen were industrious, frugal, and orderly, drinking being little known, and they were more subject to discipline and the control of their foremen than with us. Broadly speaking, it may be stated that in France nearly all raw materials employed in chemical works are much dearer than in England; that labour is cheaper; that the quality of the products manufactured is generally far superior to importations from England, the better colour and purity being easily distinguishable.

A few technical details may not be out of place before this Society. The pyrites used sometimes vary in quality, but are generally non-cupreous, and contain from 46 to 48 per cent of sulphur; the charge in the burners is light, not exceeding 7 cwts. in twenty-four hours; and the burners appear to be carefully attended to, and leave an ore containing not more than $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent of sulphur as loss. The yield of sulphuric acid, as might be expected, is very good, being about 135 per cent in the pyrites. Owing to the heat of the climate in summer, the chambers are generally entirely roofed in, and are kept very neat and clean. The men in this department, as in all other, work twelve-hour shifts, and are paid 3s. per day, as compared to 5s. in England.

In the sulphate of soda department, the furnaces are large and have three beds, but they only work about $2\frac{1}{2}$ tons of salt in twenty-four hours, as compared to 10 tons in England. This small quantity is worked chiefly with the object of obtaining a complete condensation of hydrochloric acid gas; the quality of the sulphate of soda is consequently very fine. The hydrochloric acid gas is conveyed through long cooling pipes to an extensive series of Wolff's fire-clay bottles, which are manufactured very skilfully and at moderate prices in different parts of France. It may be stated that it generally requires about one hundred of these bottles to each furnace, and the gas which finally escapes to the flue is reduced by this careful method of working to a very small percentage of loss. As far as I could calculate on the spot, this system of condensation is considerably less costly, as far as erection is concerned, than the stone or brick towers adopted in England; and even after allowing for the furnace only turning out one-third of the quantity as compared to this country, the French condenser plant is little more than half of ours, and the results appear to be better. This is shown by the green fields and growing trees, in some places, near the works. The acid obtained is also very strong, standing from 30° to 32° Tw. The workmen are paid 3s. 4d. per day of twelve hours.

The balling process, again, is differently conducted to ours. The sulphate of soda, coal, and limestone are first finely ground, and a much heavier charge of materials than we use is put into the furnace at once, but the number of balls made is fewer. For instance, in some places 17 to 18 cwts. of charge constitutes a ball, in the place of 8 cwts. as with us. Six balls only are drawn out in a twelve hours' shift; and in other works the weight is still greater, being as much as 40 cwts. for a charge, and three balls in twelve hours. Owing to the slowness of working, and the moderate fire-heat applied, it is not found necessary to use much more than the chemical equivalents in the mixture. For instance, instead of using 50 per cent of mixing coal on the sulphate, the French only use 25 to 30 per cent. The balls produced are consequently nearly a cream colour instead of being a brown-black, as with us. They are so dense and hard, however, that they find it necessary to have them broken to small pieces before

being sent to the vats. The wages in this department are 3s. 4d. per day as compared with 5s. 3d. here, but three men are required in the place of two in England. The vat-liquors are generally boiled down in open pans, from the waste heat of the ball furnace, the salt being fished out, and the remaining red liquors are used in making caustic soda.

In some works the black salt so obtained is re-dissolved in pure water, settled, and then evaporated and calcined in brick furnaces with a dished bottom, similar to those employed in England twenty-five years ago. The soda-ash obtained by this plan of working is very white and pure, and nearly resembles the English refined alkali.

This calcined ash is used in making the French soda crystals, the solution being crystallised in small metal dishes, about 15 to 18 inches diameter and 9 inches deep, producing a very good quality of soda. In a hot climate like that of France it would be found very difficult to crystallise the soda-liquors in large vessels, as in England, and the use of small vessels appears to overcome the difficulty, and the produce obtained is quite as large as in the colder climate of England. The dishes are placed in long rows, two deep and four in height, and appear to be easily worked, the cost of wages being not more than in England.

The soda is afterwards carefully dried on shelves in another department, and then packed in casks for the Paris market. Owing to the care and cleanliness throughout, and the chemical purity of the materials, the French soda brings 2 francs per cwt. more in the Paris market than soda imported from England.

I will now turn for a few moments to the bleaching-powder process. At the time of my visit the Weldon process had not yet come into operation, but several works were erecting plant for the purpose. I will, therefore, describe the old manufacture, which is so familiar to most of us in this room. Instead of using the large square stills which we have in this country, the French use a small retort made of fire-clay, and nearly similar to the Wolff's bottles already referred to. A charge of about 50 lbs. weight of ground manganese is used, and hydrochloric acid of 30° to 32° is added. In some works the vessel is heated from below by means of a flue, and in others it is heated by steam. An almost complete decomposition of the manganese takes place, which consequently produces a larger yield of bleach than in England, no manganese being practically wasted. The chlorine is conveyed part of the way to the chambers in glass pipes, so that, from the colour of the gas, it is not difficult to see when the manganese is worked off, and the still is ready for another charge. The bleach-chambers are made of stone flags, containing a series of shelves upon which the lime is spread, and the bleach is not brought up higher than 32° , which is the usual French standard. In one work which I visited as much as 6000 tons were made annually.

At some of the works it was pleasant to notice, in a social point of view, that large schools were established for the education of the children of the workmen: I visited a school where 600 children were being taught. News rooms, concert halls, and billiard rooms were also connected to these works, and on Sundays the workmen flock to these places of amusement in considerable numbers to enjoy themselves.

Chemical manufacturers in England have, for many years past, laid themselves out for the establishment of works with very large productive powers—quantity being the main thing in view. One reason given for this has been that, owing to our high-priced labour, it was absolutely necessary that a large weekly turn out should be accomplished. Apparatus in chemical works has also been constructed on a similarly gigantic scale: and in this competitive race I fear it must be acknowledged that superior colour, excellence of production, and general chemical purity have been to some extent forgotten. On the other hand, the French, with their dear materials, their small but many

times multiplied apparatus, the constant application of the chemical laboratory to every process, the cleanliness and care of their frugal and saving workmen, are producing chemical products which—although in nearly all cases dearer than in England—are certainly of superior quality, from which the English manufacturer may learn a lesson.

NOTES UPON THE ANALYSIS OF ANIMAL CHARCOAL.

THE ESTIMATION OF CARBONATE OF LIME AND LIME IN CHAR.

By G. C. STEWART, F.C.S.,
Chemist at the Cappielow Sugar Refinery, near Greenock.

FRESENIUS,* and more recently Crookes,† recommend Schiebler's volumetric process in estimating the amount of carbon dioxide gas evolved from the carbonate of lime in animal charcoal.

With all due respect to the experienced chemists who are in the habit of using this process, it appears to me clearly that the most accurate results are obtained from the gravimetric method. Now I would here wish it to be distinctly understood that it is not my purpose to condemn Schiebler's beautiful method of estimating carbon dioxide in carbonates—far from it; the fact that all other writers upon the subject at issue coincide with me that the results obtained from Schiebler's process are "about" (I mean *only* approximately) correct is sufficient. As this sort of thing does not suit me when I have occasion to analyse char, I have, after using the process (Schiebler's), gone back to the antiquated method of determining carbon dioxide in carbonates *by the loss in weight*, and I find that I get results which are admitted to be generally correct.

For the gravimetric method of determining the amount of carbon dioxide evolved from the carbonate of lime in bone-char, all that is necessary is one of those "classical" carbonic acid apparatus the production of which now-a-days make our Continental neighbours notorious in the art of glass-blowing. I recommend that from 4 to 5 grms. of the charcoal should be weighed out into the receiver of such an apparatus, and the carbonate of lime decomposed with dilute hydrochloric acid in the ordinary way, the carbon dioxide evolved from the earthy carbonate being taken as a measure of the amount of carbonate of lime actually existing in the char as such. Forty-four parts of carbon dioxide are equivalent to 100 parts of carbonate of lime.

All samples of charcoal contain a very small proportion of ferrous sulphide (FeS), which, when acted upon by the dilute hydrochloric acid, liberates sulphuretted hydrogen; but the error arising from this source (if any at all) must be very trifling indeed.

During my experience in this class of work, I have had occasion to analyse a great number of samples of animal charcoal from widely different sources, all of which contained sulphides, and, as the result of my experience, I have never found more than about half per cent of the evolved gases to be sulphuretted hydrogen.

To prevent the evolution of this gas, it is best to add a few drops of mercuric chloride to the hydrochloric acid used in the decomposition, and, of course, the only gas evolved is carbon dioxide. The results are very satisfactory in the hands of an experienced manipulator.

Free lime is not an infrequent constituent in bone-char, particularly the "stock charcoal" of sugar refineries; the amount ranges from 0.1 to 0.5 per cent. How this free lime comes there is not the question; the fact that the charcoal contains it is sufficient.

It is best estimated, also gravimetrically, by carbonating

about 5 grms. of the charcoal in a carbonic acid apparatus with solution of ammonium carbonate, and decomposing after carbonation with dilute hydrogen chloride as above.

On comparing the result obtained from this experiment with the previous one, a slight increase in carbonate of lime will no doubt be observable. This excess is calculated to (CaO) lime, and reported as such.

Chemical Laboratory,
Cappielow Sugar Refinery,
November 6, 1875.

(To be continued.)

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 266.)

This method of preparation, which is still in use, is as follows:—A known amount of concentrated hydrochloric acid is diluted in a beaker with 8 to 10 volumes of water, and exposed to a freezing mixture. A quantity of barium peroxide, somewhat less than sufficient to neutralise the acid, and as free as possible from other oxides (especially from manganic oxide, which would decrease the yield), is ground up to a fine pulp with water, and gradually added to the acid, in which it should dissolve without effervescence. Dilute sulphuric acid is then cautiously added, in order to throw down the dissolved baryta as sulphate and liberate hydrochloric acid, which then serves to react upon a further quantity of baric peroxide. After the liquid has been filtered off from the barium sulphate, a new dose of pulpy barium peroxide is added, and the above-described process is several times repeated. After the sixth or seventh addition the liquid contains a sufficient amount of the peroxide of hydrogen. If perfect freedom from acids is required, it is successively treated with sulphate of silver and hydrate of barium. The filtrate is concentrated over sulphuric acid in a vacuum.

Pelouze adds a paste of barium peroxide to a solution of hydrofluosilicic acid, and filters the solution of peroxide of hydrogen from the fluosilicate of barium.

Dupré† and Balard use a solution of carbonic acid in water for the same purpose, adding gradually very small quantities of finely pulverised peroxide of barium.

Recently J. Thomsen has proposed the following modification of Thénard's process‡:—Finely-ground peroxide of barium, or the commercial so-called hydrate, is dissolved by addition to dilute hydrochloric acid, till the latter is almost neutralised. To the filtered and cooled solution so much baryta-water is then added that foreign oxides and silica are thrown down, and a slight precipitate of barium peroxide is formed. The solution is then filtered and mixed with a sufficient quantity of concentrated baryta-water, whereby, as was shown by Brodie,|| crystalline hydrated peroxide of barium is deposited. The precipitate is filtered and washed till it no longer shows the reaction of hydrochloric acid. The hydrate thus obtained can be preserved for a long time in closed vessels in the moist state. To obtain peroxide of hydrogen it is added, with stirring, to dilute sulphuric acid. The concentration of the latter may reach 1 part of acid in 5 parts of water. When the solution shows only a very faint acid reaction the sulphate of baryta is allowed to settle, and the liquid is filtered.

(To be continued.)

* Fresenius's "Quantitative Chemical Analysis."

† Crookes's "Manufacture of Beet-Root Sugar."

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† Dupré, *Comptes Rendus*, lv., 736 and 758.

‡ Thomsen, *Ber. Chem. Ges.*, 7, 74.

|| *Pog. Ann.*, cxxi., 372.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 2nd, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. N. Gow, G. Bischof, G. W. Davey, and H. Child were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. W. H. Watson, E. H. Gaskell, T. S. Davis, S. E. Levy, W. L. Howie, M. Roberts, G. W. Wood, J. Hargreaves, H. Wilson Hake, E. Yewdall, and H. Glover. Messrs. W. Salvador Curphey, J. Hersham, Gerald Warbrick Rawlins, A. Boak, R. Lilburn Barnes, W. E. Halse, T. H. Dodd, R. Harvey, J. F. M. Harris Stone, E. H. Girling, T. McKean, A. Taylor, T. H. Bland, S. Wills, E. H. Cook, J. Campbell Oman, J. Clough Thresh, A. W. Postans, P. R. Ogle, F. C. Desvignes, F. M. Jennings, and S. A. Szczepanowski were then balotted for and duly elected.

The first paper, "*On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds*," by J. H. GLADSTONE and A. TRIBE, was read by the former. When iodine dissolved in absolute alcohol was poured on finely-divided aluminium a powerful action takes place, and hydrogen was evolved in abundance. The pasty residue in the flask, when heated to 100° C., gave off alcohol and left a solid residue, which, at 275° C., became liquid, alcohol and an oily body containing iodine passing over. The fused residue in the flask, when heated to a still higher temperature, was decomposed with formation of alcohol, ethylen, and alumina; but under diminished pressure a different result was obtained—a greenish white solid sublimed, which, on analysis, was found to be aluminic ethylate, $\text{Al}_2(\text{C}_2\text{H}_5\text{O})_6$. This is the second instance on record of an organo-metallic body containing oxygen which is capable of distillation, cacodylic oxide being the other. Similar results were obtained with aluminic iodide or aluminic bromide, and aluminium was employed instead of aluminium and free iodine, but the action was less energetic. Amylic alcohol acted in the same way as ordinary alcohol.

The PRESIDENT said they were much indebted to the authors for the account of this interesting research.

Mr. C. E. GROVES then read a "*Note on Incense Resin*," by Dr. J. STENHOUSE and himself. This resin, which is the produce of a tree indigenous to British Guiana, and is also known as "Gum Hyawa," or resin of Conima, contains, besides an essential oil, a crystalline and a non-crystalline resin. The essential oil, which is extracted in the usual way by distillation in a current of steam, has the empirical formula, C_6H_8 , and appears to belong to the $\text{C}_{15}\text{H}_{24}$ group. Conimene, which is the name the authors have assigned to it, boils at 264° C., and possesses a pleasant aromatic odour. It is polymerised by the action of sulphuric acid. The crystalline resin forms minute colourless needles of the composition $\text{C}_{46}\text{H}_{76}\text{O}$. It melts at 175°, and is but moderately soluble in boiling spirit.

The PRESIDENT having thanked the authors,

Mr. J. SPILLER read a notice "*On the Occurrence of Native Calcium Chloride at Guy's Cliffe, Warwickshire*." In the course of a tour through Warwickshire the author visited Guy's Cliffe, and on several parts of the face of the low sandstone cliff there he noticed a black slimy exudation, as if it had been bedaubed with tar, and some of this black slime was collected for examination. The results of the analysis, which was rendered somewhat difficult by the presence of dead leaves and stalks, and living algæ, were given, and show the presence of a very large percentage of calcium chloride. This material, as it is washed away by the rains, is constantly renewed, and

would seem to point to the existence of salt-beds in the neighbourhood.

The CHAIRMAN, in thanking the author, remarked no doubt there were many other gentlemen present who, like himself, had visited Guy's Cliffe without noticing this interesting substance to which Mr. Spiller had directed their attention.

Dr. THUDICUM said it would be interesting to know to what geologic period the sandstone belonged, as a considerable bed of sandstone had to be penetrated at Stassfurt before the salt-bed was reached, and a substance very similar, he believed, to that examined by Mr. Spiller had led to their discovery.

In reply to a question by Mr. T. B. Groves, the AUTHOR said the apparently black colour of the specimen was due to the dark green of the algæ present, mixed with decomposing organic matter.

Mr. G. S. JOHNSON then communicated a note "*On Certain Sources of Error in the Ultimate Analysis of Organic Substances containing Nitrogen*." The author, whilst making a combustion of an albumenoid substance with lead chromate and freshly reduced metallic copper, was anxious to ascertain if any nitrous acid had escaped reduction, and on testing the contents of the potash bulbs obtained abundant evidence of the presence of nitrous acid. On examining the original solution of potash, however, it was also found to be contaminated with potassium nitrite. This is likely to be a source of error in the carbon, as such potash absorbs oxygen, and increases in weight when a current of dry pure air is passed through it. Another source of error is the occlusion of hydrogen by metallic copper which has been reduced in a current of dry hydrogen, even if it be subsequently heated to 150° C., rendering the hydrogen determination too high.

Dr. WRIGHT said he could confirm Mr. Johnson's account of the occlusion of hydrogen by copper, for he had always observed, with nitrogenous substances burnt with lead chromate and metallic copper, that the hydrogen came about 0.5 per cent too high, whilst the excess in ordinary non-nitrogenous substances was only about 0.2.

Dr. VOELCKER said he would like to point out certain sources of error in the determination of nitrogen in highly nitrogenous bodies, especially albumenoids, if the combustion was not performed with sufficient precautions. In the first place it was necessary to have the substance very finely divided and intimately mixed with the soda-lime, otherwise the nitrogen would be too low. Again, hydrogen may not be present in sufficient quantity to cause all the nitrogen to be evolved as ammonia, but this source of error might be avoided by mixing sugar with the substance. A third cause of error was the employment of too high a temperature, as in the extreme heat of a Hofmann's gas-furnace, when the nitrogen was apt to be partly dissociated into its elements; the combustion should be performed at a dull red-heat. This loss was increased if too long a tube were used, or if the mixture was burnt too slowly. If nitrates were present along with albumenoids it was necessary, in order to obtain accurate results, to wash out and determine the nitrates and ammoniacal salts, and then burn the albumenoids in the usual way.

Dr. ARMSTRONG said he could confirm the observation about the occlusion of hydrogen by metallic copper, for in the combustion in a vacuum, after a good one had been obtained by the Sprengel pump, as soon as the copper was heated the vacuum diminished, showing that gas had been given off. He found it advantageous to substitute silver for copper, which answered admirably if strongly heated.

The CHAIRMAN, in thanking the author, said he was glad this paper had served to introduce such a valuable and interesting discussion.

A paper "*On Certain Bismuth Compounds*," by Mr. M. M. P. MUIR, was then read. When bismuth is heated in a current of chlorine the two unite, and a beautifully crystallised sublimate of the trichloride is obtained. It

melts at 225° to 230° C., and may be distilled unchanged in a current of dry carbonic anhydride. The tribromide was prepared in a similar way, but forms flat, brilliant, yellow crystals, which melt at 210° to 215°. The author has studied the action of water and of ammonia on the tribromide, and gives details of the results obtained, as also of the preparation of the so-called bismuthic acid by passing chlorine through bismuthous oxide, Bi_2O_3 , suspended in a boiling solution of caustic potash. It still retains traces of chlorine, however, but this may be removed by boiling the chocolate-red product with strong nitric acid, which changes it to a brilliant scarlet. It then has the composition HBiO_3 , but when heated to 120° C., it loses water, and leaves bismuthic oxide, Bi_2O_5 . The attempts to obtain salts of bismuthic acid failed.

The last communication was "*On Bismuthiferous Tesserall Pyrites*," by Dr. W. RAMSAY. It contains the results of the analysis of a specimen of this mineral from the museum of Glasgow University. The formula deduced is $(\text{Ni,Cu,Fe})(\text{AsBi})_3$.

The meeting then adjourned until Thursday, December 16, for which the following papers are announced:—"On Narcotine, Cotarnine, and Hydro-cotarnine (Part III.)," by C. R. A. Wright and G. H. Beckett; "Communications from the Laboratory of the London Institution," by H. E. Armstrong; "On the Sebates of the Alcoholic Series, and Note on Sebate of Cobalt," by E. Neison; and "On some Compounds of Ether with Anhydrous Metallic Chlorides," by P. P. Bedson.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

JOHN PATTINSON, President, in the Chair.

PRESIDENT'S ADDRESS.

(Continued from p. 266.)

THE supply of water to towns has excited much attention of late, and many towns have had to suffer from an insufficient supply as well as from bad quality. In our own district, as you all know, we have from time to time been supplied with water so muddy as to be unfit for use even in baths. In the frequent examinations of this water it has been my duty to make, I have usually found it of good quality when separated by filtration from the matters it held in suspension. But surely in the water supply of a large town like ours, containing many thousands of inhabitants unable to take means to filter the water themselves, it is not too much to expect that this necessary of life should be supplied in such a condition of clearness as to be fairly suitable for drinking purposes. So long as the source of supply is to a great extent from surface drainage, from whatever district it is taken, we may expect that the water will occasionally be turbid owing to high winds or from the accession of flood water. Even the famed Loch Katrine water is from time to time reported by the official examiner as being turbid. Only deep-well waters, such as the Sunderland water, are free from this objection. The only effectual remedy for this turbidity is to have the water carefully and thoroughly filtered by passing it through beds of gravel and sand before it is allowed to enter the mains for distribution. This is an operation which can be readily and economically accomplished. All the surface water supply of London is treated in this way. The Newcastle and Gateshead Water Company are now preparing filters for this purpose, so that we may hope shortly to be supplied with water reasonably free from suspended matter at all times and fairly suitable for drinking. In order to have a very bright and pleasant water it will probably still be necessary to use house filters. These can now be had at a moderate price, and they do their work very effectively if they are not choked up by the very muddy water which

it is now sometimes necessary to pass through them. Those provided with a sponge to remove the most of the insoluble matter, and which can be readily taken out and cleaned, are perhaps the most useful. It is now well known that a good filter not only separates insoluble matters (to which at one time its action was thought to be limited), but it also oxidises and removes the organic matters in solution. The following analysis shows the effect of filtration on a sample of water in this respect—the figures represent grains per gallon:—

| | Unfiltered. | Filtered. |
|--|-------------|-----------|
| | gr. | gr. |
| Nitrogen existing as ammonia.. .. | 0'001 | 0'001 |
| Albumenoid nitrogen.. .. | 0'007 | 0'004 |
| Nitrogen existing as nitrites and nitrates | 0'064 | 0'046 |
| Oxygen required to oxidise organic matters (permanganate test) .. | 0'074 | 0'014 |

The unfiltered water also contained a considerable amount of matters in suspension which was also removed by the filter.

The Sale of Food and Drugs Act has become law during the last session of Parliament. There is no doubt that, in many respects, this Act is a great improvement on the Adulteration Acts it supersedes. Provision is made to secure the punishment of the real offender when food or drugs have been tampered with, and to protect the retail dealer who may not have the opportunity of knowing whether or not his goods are pure; the inspectors appointed to take samples can now compel the sale to them of a reasonable quantity of the article suspected to be adulterated; if the accuracy of the chemist's analysis be disputed, the seller has the right to have the sample sent for analysis to the chemical officers of the Inland Revenue Department, as well as the right of appeal to a superior court; and many other improvements are introduced. One of the articles of food which is still most extensively adulterated is milk. Most of the cows which have been obtained, both in our own district and elsewhere, have been for selling mixtures of milk and water. So long as paltry fines of about 10s. are imposed by the magistrates for this offence, we are still likely to have much milk adulteration practised. The dealers can well afford to pay an insignificant fine of this kind out of the plunder they obtain from the sale of water at the price of milk in the ninety-nine cases out of a hundred in which they escape detection.

A subject of very great importance to this district is now being investigated by a Royal Commission. I allude to the subject of the spontaneous combustion of coal in coal-laden vessels. There has lately been a considerable increase in the number of cases of fire arising from this cause. From statistics collected by Mr. R. Cooper Rundell, and given by him in a Report to the Underwriters' Association of Liverpool, it appears that, taking the number of vessels carrying upwards of 500 tons of coal which have sailed from the United Kingdom for ports south of the Equator during the first nine months of the years 1873 and 1874, the number of casualties from spontaneous combustion was 23, or about 2 per cent of the total number of vessels in 1873, and 50, or about 4 per cent in 1874. The statistics further show that the fires are not confined to one kind of coal, but have occurred in most, if not all, kinds exported from all parts of the United Kingdom. The theory which attributes spontaneous combustion to the presence of pyrites in the coal is consistent with the recent increased number of cases, if we consider that owing to the extraordinary demand for coals and a high price of labour, the coals were more likely to be shipped without being so carefully freed from "brasses" or iron pyrites in later years than they were formerly. On the other hand, Richters has pointed out that, in the kinds of coal he experimented with, the coal which contains most pyrites is not that which is most liable to spontaneous combustion; and

his researches have shown that atmospheric air is rapidly absorbed by coal, and that the oxygen thus absorbed probably afterwards combines with the organic constituents forming carbonic acid and developing heat. In all probability the heat which gives rise to spontaneous combustion is developed both by the oxidation of iron pyrites as well as by the oxidation of the carbonaceous constituents of the coal; and that in the holds of vessels, where large cargoes of coal lie unventilated, or but imperfectly ventilated, this heat accumulates, and may ultimately be high enough to set fire to the cargo. The whole subject requires further investigation, and the Royal Commission now formed will, no doubt, not only elicit valuable information as to the causes of these sad disasters, but also suggest means of preventing them.

In our chemical works a few cases have recently been known where bleaching-powder has spontaneously heated so as to set fire to the casks in which it was packed. So far as I am aware, these cases have only occurred when the bleaching-powder has been rapidly made and hurriedly packed. If this be so, the heating can be readily avoided. But the phenomena of the heat of chemical action are constantly being met with in our chemical operations, and are in many cases but imperfectly understood. A knowledge of the laws regulating the development and absorption of heat, both of chemical action and of ordinary combustion, is of the utmost value to the technologist, and is almost indispensable for the intelligent and economical working of many of the new processes recently introduced into our chemical works. How valuable an intimate knowledge of these laws may become has been well shown in the admirable researches on the "Chemistry of the Blast Furnace," by our first president, Mr. Bell. Many a useless and expensive experiment would be avoided, and many hitherto inexplicable phenomena would be understood, if our technologists would make themselves thoroughly acquainted with these laws so far as they are known.

The inaugural address of a society like ours appears to me to afford a suitable opportunity for placing on record a notice of the various new processes and improvements which, from time to time, are introduced into the chemical arts and manufactures; and I now purpose, very briefly, to describe some of the most notable of these inventions which have been recently brought into practical use, both here and elsewhere.

Although many and great improvements have from time to time been made in almost every stage of the manufacture of soda, which forms the staple of the chemical trade of this district, yet the process in its main features still remains the same as when it left the hands of the famous Le Blanc; and, so far as can be seen at present, the great bulk of the carbonate and hydrate of soda required by the civilised world is still likely in the future to be produced by furnacing sulphate of soda with chalk, or limestone and coal. The only rival plan which has hitherto met with any measure of success is the so-called "ammonia process," in which common salt is decomposed by bicarbonate of ammonia. In England this process is now carried on somewhat extensively, I believe, by Messrs. Brunner and Mond, of Northwich. The obligations imposed upon these gentlemen by the patentees of the process prohibit their revealing any particulars as to the exact mode of procedure. It is certain, however, that a very pure carbonate of soda is produced, and that this is now meeting with a ready sale for glass making, for which purpose, owing to its freedom from sulphates and other impurities, it is well adapted. Messrs. Brunner and Mond appear to have succeeded in overcoming the objection which some glass makers have had to their produce on the score of its being more bulky than the refined alkali made by the ordinary process. By the kind permission of Messrs. Reid and Hall, Messrs. Brunner and Mond's agents in this district, I am enabled to give the following complete analysis of this ammonia-made carbonate of soda. The

sample was taken by me from a parcel of several casks, and the analysis was made in my laboratory:—

| | Per cent. |
|-------------------------------|--------------------|
| Carbonate of soda | 98.72 |
| Sulphate of soda | 0.20 |
| Chloride of sodium | 0.54 |
| Carbonate of lime | 0.13 |
| Carbonate of magnesia | 0.04 |
| Peroxide of iron | 0.01 |
| Alumina | 0.01 |
| Silica | 0.09 |
| Moisture | 0.32 |
| | <hr/> 100.06 <hr/> |

Soda by English alkalimetric test.. 58.50

It will be seen that this is a very pure article. Other samples have been examined by me which contained as much as 58.7 per cent of soda by the English commercial test.

It is said that the plant required in this process is of a very delicate nature, and very liable to get out of order, and that the alkali is produced at a very high cost as compared with that produced by the ordinary process; so that, excepting for fine glass making, and for other purposes where extreme purity is of greater importance than price, it is not likely to meet with very extensive application. Moreover, it is said that 5 per cent of the ammonia used in the process is lost for every ton of alkali made. If this be so, were all the ammonia produced in the distillation of coal for gas making in the United Kingdom diverted from its important uses in agriculture and other purposes, and used for restoring the waste in this process, it would only, I estimate, be sufficient for about three-fourths of the soda-ash at present made by the Le Blanc process in the United Kingdom. But long before this point could be reached ammonia would rise to a prohibitory price. Unless, therefore, some other source of ammonia be discovered this process can only have a comparatively limited application.

(To be continued.)

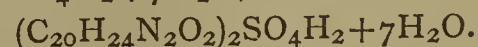
CORRESPONDENCE.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

SIR,—I am obliged to your correspondent for pointing out an error in a foot-note to one of the Appendices of the Sixth Report of the Rivers Commission.

The error in question is entirely an editorial one, made by myself, and has no bearing whatever upon the accuracy of the analytical results, which were obtained by Mr. W. Thorp, late chief analyst in the laboratory of the Rivers Commission. It occurred in the following way:—The results of the experiments quoted by your correspondent were sent to me from the Rivers Commission Laboratory, by Mr. Thorp, in the following form: "1 litre of pure water containing 0.001 grm. nitrogen as sulphate of quinine (C. = 0.008571 grm.) gave 0.000996 grm. N. and 0.00912 grm. C." In writing the article on potable water for Dr. Hofmann's "Report on the Development of the Chemical Arts during the last Ten Years," I wished to give the weights of sulphate of quinine which contained the specified quantities of nitrogen and carbon; and, in calculating these weights I inadvertently used the formula $C_{20}H_{24}N_2O_2 \cdot SO_4H_2 + 7H_2O$, instead of—



From this article the error was copied into the foot-note already alluded to.

The bottle containing the standard solution of sulphate of quinine employed in the experiments is now in my

possession in this laboratory, but at the time the article was written for Dr. Hofmann it was in the Rivers Commission Laboratory in Westminster, and I could not conveniently refer to its label, from which I now copy—"Sulphate of quinine, $\frac{1}{2}$ litre = 0.7786 grm. = 0.05 grm. N. 10 c.c. = 0.001 grm. N."

The following is therefore the corrected statement of the calculated and experimental results referred to by your correspondent:—

To 100,000 parts of a sample of water rendered as nearly chemically pure as possible, 1.5572 parts of sulphate of quinine were added. The following data compare the quantities of organic carbon and organic nitrogen thus actually added to the water, with those afterwards found in two analyses:—

| | Present. | Found. | |
|---|-------------|--------|-------|
| | | I. | II. |
| Organic carbon in 100,000 parts of water.. .. . | 0.857 part. | 0.912 | 0.904 |
| Organic nitrogen in do. do... | 0.100 ,, | 0.0996 | 0.098 |

To 100,000 parts of a similar sample of water 0.7786 part of sulphate of quinine was added, and the following results obtained on analysis:—

| | Present. | Found. | | |
|--|-------------|--------|-------|-------|
| | | I. | II. | III. |
| Organic carbon in 100,000 parts of water | 0.429 part. | 0.435 | 0.442 | 0.440 |
| Organic nitrogen in do. do. | 0.050 ,, | 0.047 | 0.048 | 0.048 |

To 100,000 parts of a third similar sample of pure water 0.07786 part of sulphate of quinine was added. On analysis this water yielded the following numbers:—

| | Present. | Found. | | |
|--|-------------|--------|-------|-------|
| | | I. | II. | III. |
| Organic carbon in 100,000 parts of water | 0.043 part. | 0.047 | 0.050 | 0.055 |
| Organic nitrogen in do. do. | 0.005 ,, | 0.006 | 0.005 | 0.006 |

—I am, &c.,

E. FRANKLAND.

Royal College of Chemistry, South Kensington Museum,
December 6, 1875.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

SIR,—The letter on the Report of the above Commission which appeared in your issue of the 3rd inst. demands a reply from me.

Dr. Frankland has, I believe, written to you explaining the error which led to the insertion in the Report of the statement that "1.957 parts of sulphate of quinine" were employed, so that I need say nothing on that point, but proceed to describe the exact mode in which the experiments were made.

From his calculation that 1.957 parts of sulphate of quinine contain 0.1469 part of nitrogen, it appears that your correspondent assumes that the anhydrous salt was employed; but this was not the case, the ordinary hydrated sulphate being used. A solution was made containing in $\frac{1}{2}$ a litre 0.7786 grm. of the salt, and 10 c.c. of this, when made up to a litre with pure water, produced a solution containing 1.5572 parts of sulphate of quinine, or 0.1 part of nitrogen in 100,000 parts. The formula which I employed was that given in Miller's "Elements of Chemistry," viz., $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$, but two others have been proposed. In Watts's "Dictionary of Chemistry" $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7\frac{1}{2}H_2O$ is given, and in Schorlemmer's "Chemistry of the Carbon Compounds" $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 8H_2O$; but if either of these be taken as correct, instead of that given by Miller, the facts are not materially altered. If the salt used contained $7\frac{1}{2}H_2O$ the quantity of nitrogen in 1.5572 parts would be 0.099 part instead of 0.1 part, and if it contained

$8H_2O$ it would be 0.098 part, and the numbers actually obtained in the analyses correspond still more closely with these than with the first number 0.1.

In reporting to Dr. Frankland the results of these experiments I did not state the quantity of sulphate of quinine used, but merely said that a certain quantity of nitrogen, in the form of sulphate of quinine, had been employed.

It will thus be seen that the accidental error in the Report which has given occasion to this correspondence in no way affects the accuracy of the experiments.—I am, &c.,

WILLIAM THORP, jun.,
Late Chief Assistant in the Laboratory of the
Rivers Commission.

39, Sandringham Road, E.,
December 6, 1875.

TESTING SODA-ASH.

To the Editor of the Chemical News.

SIR,—In your impression of last week (CHEM. NEWS vol. xxxii., p. 267), in the Report of Mr. Pattison's Address to the Newcastle-on-Tyne Chemical Society, he refers to the difference in the estimate in testing soda-ash, &c., existing between the chemists on the Tyne and those in Liverpool: surely, then, this is a matter that should be cleared up in this advanced age of commercial chemistry. I fear I may intrude too far on your space, but I will narrate an occurrence of the old times of our "barilla" and "kelp" alkali (before the days of "Soude-factice") bearing upon the present point. A large parcel of Spanish barilla was sold, the value to be decided by two analytical chemists of that day—one on the part of the merchant, the other for the buyer, a soap-maker. Their reports differed somewhat widely. Upon this it was agreed to refer the case to the great Faraday (I must so term him): his report as to its value again differed from the other two. Upon being told this, *he* said he could go no further into the matter, but if those two gentlemen would come to him he would show them how they were wrong. This was told me by my father, and he and those referred to have all since passed away.

In conclusion, I must declare that *we*—as consumers of the soda-ash—ought only to be called upon to pay for the actual soda therein (the only value to us), and not for apparent value, by absorption of the "test" acid, by the lower oxides of sulphur than the sulphates. I could say a great deal more on this subject, but for the reason I have above stated. I need scarcely say I am *not* an analytical chemist, but—I am, &c.,

A SOAP-MAKER.

Southwark, December 7, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—Your correspondent "Carbon" wishes to know how the loss arises from the use of acid containing arsenic in the manufacture of white ammonium sulphate. If "Carbon" had ever such acid in hand to make this salt with, he would have found to his cost the cause of the loss. The sulphate acquires such a disagreeable dirty yellow colour from the presence of arsenic trisulphide that buyers will not look at it except a large slice is cut from the price. "Grey" or even "black" sulphate would be taken in preference. Inexperienced persons might imagine that iron was the colouring agent, but of course ferrous sulphate imparts a green tinge to the salt, turning rusty by age. The remedy is easy, and no chemist could be taken in with such acid a second time. In my own experience I have only once met with an acid so rich in arsenic as to produce the effect described, but possibly others may have been oftener tried, as I always insisted where any voice was left to me upon the use of "sulphur" vitriol, as long as the prejudice exists for buying by colour

instead of ammoniacal richness and freedom from sulphocyanide.—I am, &c.,

R. FRAZER SMITH.

Greenock, November 29, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

SIR,—My note in your Journal (CHEM. NEWS, vol. xxxii., p. 225) was intended to elicit what substances have been observed to crystallise (perfectly or nearly so) in the following forms, viz.:—The oblique sphenoid, the doubly-oblique sphenoid, the doubly-oblique rectangular prism, the doubly-oblique rectangular pyramid, the doubly-oblique rhombic prism, and the doubly-oblique rhombic pyramid.

Allow me to apologise for writing the word *sphenoid*, in my former note, so badly that your compositor should read it *spheroid*. The "morphology of crystals" is sufficiently perplexing without the invention of any new terms, and certainly I have no such desire. The question I have asked is interesting, and possibly important.—I am, &c.,

T. A. READWIN.

November 30, 1875.

"THE BIRTH OF CHEMISTRY."

To the Editor of the Chemical News.

SIR,—A recent number of the CHEMICAL NEWS (vol. xxxii., p. 144) contains a letter from Mr. Rodwell, author of "The Birth of Chemistry," referring to my "Outlines of a Bibliography of the History of Chemistry," which you did me the honour of republishing. Mr. Rodwell, in his letter, makes use of the following language with reference to our knowledge of the chemistry of the Egyptians:—"When we remember that the science originated in Egypt, and that the very name is derived from an Egyptian source, we can but hope that—in the progress of Egyptian discovery—as valuable information in regard to the history of chemistry as has already been found in regard to astronomy may be brought to light."

This hope has been in some measure realised by the appearance of a facsimile of an Egyptian medical treatise written in the 16th century, B.C., which, when fully deciphered, will undoubtedly prove of immense value to the student of the history of chemistry. The title of this work (translated) is as follows:—"Papyrus Ebers, the Hermetic Book of Medicines of the Ancient Egyptians, in Hieratic Writing. Published, with Synopsis of Contents and Introduction, by George Ebers. . . . Leipzig: William Engelmann. 1875. 2 vols., folio."

This is not the place to enter upon a description of this remarkable document; we can only call attention to its probable age and authorship. Palæographic studies of the manuscript, the occurrence of the names of kings, and a calendar written on the back of the first page, have enabled Ebers to assign the writing to the middle of the 16th century, or, more precisely, B.C. 1552; in short, prior to the exodus of the Israelites.

The authorship of this ancient treatise is not revealed, but it bears internal evidence of being one of the six Hermetic books on Medicine named by Clement of Alexandria, and is ascribed, on the first page, to the god *Thuti* (or *Thoth*), the famous Hermes Trismegistus of the Greeks. At the time of Jamblichus, A.D. 363, the priests of Egypt showed forty-two books attributed to Hermes (Thuti). Of these, thirty-six contained the history of all human knowledge; the last six treated of anatomy, of disease, of affections of the eye, instruments of surgery, and of medicines. The "Papyrus Ebers" is indisputably one of these ancient Hermetic works.

Ebers gives a Synopsis of the contents of the entire work, and a literal translation of the first two pages of

the roll (of which there are 110 in all), reserving a complete translation with commentary for a future publication. Since the "Papyrus" is marvellously well preserved, and does not speak vaguely of incomprehensible and fantastic ideas, but furnishes indubitable insight into different phases of Egyptian manners and customs, the archæologist and historian, as well as the student of science, will await with impatience the fuller translation promised.—I am, &c.,

H. CARRINGTON BOLTON.

School of Mines, Columbia College, New York,
November 26, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 20, November 15, 1875.

Specific Gravity of Pure Platinum and Iridium and their Alloys.—MM. H. Sainte-Claire Deville and H. Debray.—Pure platinum was found to have the specific gravity 21.504. Iridium gave 22.421. An alloy of 90 platinum with 10 iridium 21.615, showing a contraction of 0.0012. Another alloy of 85 platinum and 15 iridium was found 21.618, the contraction being 0.0003. An alloy of 66.67 platinum and 33.33 iridium gave 21.874, the contraction amounting to 0.0034. A brittle alloy of 5 platinum with 95 iridium = 22.384, and the contraction was 0.0006. The specific gravities of platinum and iridium are higher than have been hitherto found, and the specific gravities of the alloys increase in a very regular proportion, which affords a presumption in favour of their purity.

Researches on the Constitution of Dissolved Salts and Acids.—M. Berthelot.—Reserved for insertion in full.

Memoir on the Measure of the Affinities between the Liquids of Organised Bodies by means of Electromotive Forces.—M. Becquerel.—Not adapted for abstraction.

Fifteenth Note on the Electro-Conductivity of Sparingly Conductive Bodies.—M. Th. du Moncel.

Certain Compounds of Titanium.—MM. C. Friedel and J. Guerin.—In a certain number of its compounds titanium is unquestionably analogous with silicium. The researches of M. Marignac on the fluo-salts of silicium, titanium, tin, and zirconium, have brought certain of these analogies to light. Other analogies result from the comparison of the chlorides, bromides, and iodides of silicium and titanium, and between the ethereal compounds of titanium and the ethyl-titanic trichlorhydrate of Friedel and Crafts, and the titanate ether of Demarcay. Along with these resemblances we find also differences. We know of no silicates resembling the known titanates. Hypersthen, the mineral which most nearly approaches in its composition to the numerous and varied titanates of iron, offers no analogy to them in form and aspect. Of the three forms of crystalline titanate acid, not one approaches that of silica. The authors, therefore, deemed it important to undertake a re-examination of certain compounds of titanium, and have studied the dichloride and the dititanic hexa-chloride.

Solution of Platinum in Sulphuric Acid during the Industrial Process of Concentration.—M. Scheurer-Kestner.—The author concludes from his experiments that the loss of weight in platinum stills is not due to a simple mechanical action of the boiling acid. When the acid is free from nitrous compounds it dissolves about 1 gram. of platinum for 1000 kilos. of acid concentrated to 94-100. If the concentration is carried to 98-100, 6 to 7

grms. are dissolved, and 9 if the acid is prepared at 99.5 per cent. If nitrous compounds are present the amount of metal dissolved is in much larger proportion. Platinum alloyed with iridium is much less attacked, an advantage, however, which is, to a great extent, compensated by the brittleness of the alloy.

New Alkaloid, Ergotinin, found in the Ergot of Rye.—M. Ch. Tanret.—This compound is a fixed solid, exists only in very small amount, and is very readily affected by the air, which renders its extraction difficult. Like all the alkaloids it has a decided alkaline reaction, and saturates acids. It yields precipitates with the double iodides of mercury and potassium, with the ioduretted iodide of potassium, phospho-molybdic acid, tannin, chloride of gold, chloride of platinum, and bromine water. Its most striking reaction is the colour which it gives with moderately concentrated sulphuric acid—a yellowish red, which becomes an intense violet-blue. If it has been exposed to the air for some minutes it loses its distinctness, and finally is no longer produced. Its saline solutions, on exposure to the air, quickly become rose coloured, and then red. If the extractive liquor is distilled with a concentrated solution of soda or potassa, mere traces of the alkaloid are obtained, but, instead, a large amount of methylamin—doubtless a product of its decomposition. In another experiment, where the liquid had been submitted to prolonged evaporation in the air, nothing but ammonia was obtained, all the alkaloid having disappeared. The great instability of this alkaloid may explain the rapid alteration of the powder of ergotised rye.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 11, November 11, 1875.

This issue contains no chemical or physical matter except what has been already noticed elsewhere.

No. 12, November 18, 1875.

This issue contains a notice of an establishment at New York for preserving fish, &c., by cold.

M. Schröder, of Baltimore, proposes to convey the American mails to Hamburg, Paris, and Lisbon in six days. He hopes to effect this by means of an invention for steering balloons, and which is to enable him to cross the Atlantic in fifty hours.

M. Toselli has made great improvements in diving-bells and in machines for grappling and raising objects from the bottom of the sea. He makes use of a powerful electric lamp. When this lamp is in action multitudes of fishes of all sizes collect around it. M. Toselli proposes, as a new kind of fishery, to kill them by the explosion of a torpedo. (We presume the torpedo will have the discretion not to damage the electric lamp.)

Two projects are put forward for dealing with the sewage of Paris. The one proposes to extend the conduits of Gennevilliers to the forest of St. Germain, and increase the surface of land to be irrigated. The other is to construct, at the expense of 70 to 80 million francs, a special canal conveying the sewage to the sea. The latter scheme is strongly supported by the Municipal Council.

M. Reimann's Färber Zeitung,
No. 43, 1875.

This issue contains receipts for a green and a grey on half-woollen goods; for dyeing and finishing blue shirtings; and for printing a puce, red, and rose (garancin style).

No. 44, 1875.

In a notice on the incrustations in steam-boilers it is shown that they may be prevented, either by the introduction of metallic zinc, or by adding to the water milk of lime sufficient to convert any acid carbonate of lime into the mono-carbonate.

There are various dyeing receipts of no especial interest.

MISCELLANEOUS.

Obituary.—With regret we announce the death, on the 30th of November, of M. Emile Kopp, the Professor of Chemistry at the Polytechnic School of Zurich. This distinguished chemist, whose valuable researches we have so often had occasion to record, was in the fifty-ninth year of his age. The cause of his death was an attack of apoplexy.

Royal Institution of Great Britain.—At the General Monthly Meeting, held on Monday, December 6, 1875, the following arrangements of the Lectures before Easter, 1876, were announced:—

Prof. Tyndall, D.C.L., LL.D., F.R.S.—Six Lectures, adapted to a juvenile auditory, on "Experimental Electricity." On Dec. 28 (Tuesday), 30, 1875; Jan. 1, 4, 6, and 8, 1876.

Prof. Alfred H. Garrod.—Twelve Lectures on the "Classification of Vertebrated Animals." On Tuesdays, Jan. 18 to April 4.

Prof. Gladstone, F.R.S.—Eight Lectures on the "Chemistry of the Non-Metallic Elements." On Thursdays, Jan. 20 to March 9.

Wm. Spottiswoode, Esq., LL.D., Treas. R.S., Sec. R.I.—Four Lectures on "Polarised Light." On Thursdays, March 16 to April 6.

R. P. Pullan, Esq., M.R.I.B.A.—Three Lectures on his "Excavations in Asia Minor." On Saturdays, Jan. 22, 29, and Feb. 5.

W. T. Thiselton Dyer, M.A., B.Sc., F.L.S., Assistant-Director, Royal Gardens, Kew.—Four Lectures on the "Vegetable Kingdom; the Boundaries and Connections of its Larger Groups." On Saturdays, February 12 to March 4.

Prof. G. Croom Robertson, M.A.—Three Lectures on the "Human Senses." On Saturdays, March 11, 18, and 25.

Edward Dannreuther, Esq.—Two Lectures on "Wagner and his Trilogy," with pianoforte illustrations. On Saturdays, April 1 and 8.

The Friday Evening Meetings will begin on January 21, 1876, at 8 o'clock; the Discourse by Prof. Tyndall, at 9 p.m. The succeeding Discourses will probably be given by Prof. Huxley, Mr. W. Preece, Mr. Wm. Crookes, Dr. C. W. Siemens, Lord Lindsay, Earl Stanhope, Prof. W. H. Flower, Sir H. S. Maine, Prof. Odling, Mr. E. B. Tylor, and Prof. James Dewar. To these meetings Members and their friends only are admitted.

University of London.—The following is a list of the candidates who have passed the recent B.Sc. Examination for Honours:—

Mathematics and Natural Philosophy (B.A. and B.Sc. conjointly).—First Class: R. C. Rowe, B.A. (Scholarship), Trinity College, Cambridge; H. F. Morley, B.A., University College. Second Class: W. H. Bennett, B.A., Lanc. Indep. and Owens Coll.

Chemistry (B.Sc. only).—First Class: J. M. H. Munro, Royal Coll. of Science, Dublin; A. J. Smith, Owens College; S. P. Thompson, B.A., Royal School of Mines. Third Class: F. A. Cooper, Owens and University Colleges; J. E. Harris, B.A., private study; C. M. Thompson, University College.

NOTES AND QUERIES.

Coal-Tar.—A Subscriber will be glad to be informed of the best and most recent authority on the chemistry and distillation of coal-tars, showing the character, boiling-points, and specific gravity of the various products.

Magnesia Bricks.—Can you or any of your readers inform me where and how magnesia bricks are made, or where I can get information on the subject?—P. D.

TO CORRESPONDENTS.

Inquirer.—(1) Angell and Hehner's "Butter; its Analysis and Adulterations" is published by Daldy, Isbister, and Co., 56, Ludgate Hill, E.C. (2) Suffolk's "Microscopical Manipulation," price 3s. 6d., published at our office.

THE CHEMICAL NEWS.

VOL. XXXII. No. 838.

ON THE ESTIMATION OF ARSENIC AS MAGNESIUM AMMONIUM ARSENIATE AND AS MAGNESIUM PYRO-ARSENIATE.

By R. W. EMERSON MACIVOR, F.C.S.,
Mem. Phys. Soc. Lond.

THE present communication contains an account of a series of experiments on the methods of Levöl and Rose for estimating arsenic. I was induced to take the matter up from the circumstance of my having been compelled to reject Levöl's process, on account of its yielding low results, while engaged in making some accurate determinations of arsenic. I was subsequently led to study Rose's method.

Levöl's Method: Determination as Magnesium Ammonium Arseniate.—This process, as commonly recommended in analytical handbooks, may be briefly described as follows:—The arsenic, after separation from other metals, is obtained in solution as arsenic acid, and then converted into ammonium arseniate by the addition of excess of ammonia. A solution of magnesium sulphate, containing sufficient ammonium chloride to prevent the precipitation of magnesium hydrate, is next added, and the whole allowed to stand for about twelve hours, so as to render the precipitation of the arsenic complete. The $\text{MgNH}_4\text{AsO}_4 + 6\text{H}_2\text{O}$ is collected on a tared filter, washed with dilute ammonia, dried in an air-chamber at a temperature of 105° to 110° C. until weight becomes constant, when the dried precipitate is assumed to have a composition represented by the formula $2\text{MgNH}_4\text{AsO}_4 + \text{H}_2\text{O}$. Regarding the reliability of this method, chemists express diverse opinions. Some, as Fresenius, Field, Wittstein, and Puller, consider it reliable, while others again, as Rammelsberg and Parnell, condemn it as yielding only approximate results. For my own part I share the opinion of the last named chemists. As already mentioned, I obtained low results with the process, and was consequently led to doubt the correctness of the formula assigned to the arseniate as expressing its composition after drying at 110° . A number of experiments on the effect of different temperatures on the salt were accordingly made.

The arseniate employed was prepared as follows:—A solution of pure arsenic acid was rendered strongly alkaline with ammonia, and carefully-prepared "magnesia mixture" added. The precipitate was thoroughly washed with cold water, partially dried between the folds of bibulous paper, and finally thoroughly desiccated over oil of vitriol. A portion of the dried salt was then submitted to analysis, with the following result:—

| | | | | | | |
|----|----|----|----|----|----|-------|
| Mg | .. | .. | .. | .. | .. | 8.25 |
| As | .. | .. | .. | .. | .. | 25.82 |

The theoretical percentages of arsenic and magnesium contained in $\text{MgNH}_4(\text{AsO}_4) + 6\text{H}_2\text{O}$ are:—

| | | | | | | |
|----|----|----|----|----|----|-------|
| Mg | .. | .. | .. | .. | .. | 8.31 |
| As | .. | .. | .. | .. | .. | 25.95 |

It is evident, therefore, that the salt has, as already found by Rose, this composition after drying over ordinary vitriol.

Having proved the composition of my salt, the following experiments were proceeded with:—1.5015 grm. was maintained at 105° to 110° until weight became constant. The total loss amounted to 0.5832 grm. = 38.84 per cent.

1.3050 dried at 105° to 107° lost 0.4943 grm. = 37.88 per cent.

1.4550 grm. by drying at 100° lost 0.5439 grm. = 37.38 per cent.

1.0820 lost 0.3682 grm. = 34.05 per cent. after about twenty hours' heating at 95° .

Assuming $2\text{MgNH}_4\text{AsO}_4 + 6\text{H}_2\text{O}$ to lose 11 molecules of water by drying at 105° to 110° , the total theoretical loss would be 34.25 per cent.—a number much below that actually found. If we, however, assume, with Field, that the salt loses the whole of its six molecules of water, the percentage loss rises to 37.37. This number is considerably lower than the loss found to take place at 105° to 110° , but agrees very well with that taking place at 100° . Field's view, however, is untenable, since I found ammonia to be expelled from the arseniate at a temperature somewhat below 100° .

In order to determine the quantity of ammonia given off at 105° to 110° the following experiment was made:—A weighed quantity of arseniate was introduced into a tube, so arranged that it could be kept at any required temperature, and connected at one extremity with a U-shaped tube containing dilute hydrochloric acid, and which in its turn was attached to an aspirator, by means of which a slow current of air was maintained passing through the tubes. The tube containing the arseniate was heated to 105° to 110° for about two hours, when the contents of the U tube were transferred to a porcelain basin, and the ammonium chloride determined with platinum tetrachloride. The platinum-ammonium chloride was, by ignition, converted into metallic platinum, which was then weighed. 2.0514 grm. $\text{MgNH}_4\text{AsO}_4 + 6\text{H}_2\text{O}$ gave 1.0464 grms. $\text{Pt} = 0.0903 \text{ NH}_3 = 4.4$ per cent.

From the above results I draw the conclusion that Levöl's method—as commonly recommended in textbooks—can only yield approximate results.

Before concluding this portion of my paper I may mention that the expulsion of ammonia from the double arseniate was first noticed by E. W. Parnell, and more recently by Rammelsberg. It is now almost two years since I first made the observation in the laboratory of Professor G. Bischoff and, consequently, long prior to the publication of Rammelsberg's paper, and I was not aware of the fact having been already established until my attention was drawn to Parnell's paper by Dr. W. Ramsay.

Rose's Method: Determination as Magnesium Pyro-arseniate.—As in the case of Levöl's process, diversity of opinion exists regarding the validity of this method. It is upheld by Levöl, Rammelsberg, Thorpe, Puller, and Wittstein, and condemned by Fresenius and Parnell. My experiments fully confirm the excellence of the process. I do not, however, find it necessary to observe many of the precautions recommended by Puller, Wittstein, and others. My mode of working the process is as follows:—

The double arseniate is dried at 120° , introduced into a porcelain crucible and heated in an air-bath first at about 140° , and afterwards at 180° , then over a Bunsen burner, the flame of which is slowly raised, and finally finishing over the blowpipe.

Scientific Chemical Laboratory,
Andersonian University, Glasgow.

ON THE PYROLOGICAL COMBINATION OF ZINC WITH HYDRIC METAPHOSPHATE.

By W. A. ROSS.

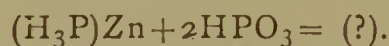
THE following experiment was made with the view of attempting a solution of the question as to the origin of hydrogen evolved:—

(1.) The procedure is based upon the observation that a fragment of pure zinc contained in a bead of fused phosphoric acid, which latter is gently heated before a long (or

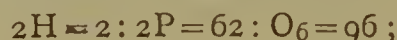
peroxidising) pyrocone* of the blowpipe, is (apparently) decomposed with considerable detonation, accompanied by brilliant phosphorescent scintillation, and the evolution of copious bubbles of gas, having the smell of what chemists call phosphine, or hydric phosphide, or phosphuretted hydrogen.

| | |
|--|---------|
| | M.grms. |
| (2.) On December 1, 1875, a clean, new, platinum wire, ringed at one end with (δ) forceps†, was weighed in a Freiburg assay balance; weight .. | = 60.1 |
| (3.) This wire, having a bead of phosphoric acid fused on it, weighed | 137.5 |
| (4.) Therefore the phosphoric acid bead weighed .. | 77.4 |
| (5.) The bead and wire, after the former had been submitted to the strongest OP‡ for sixty seconds, weighed | 126.0 |
| (6.) Loss in weight from the volatilisation of pure phosphoric acid | 11.5 |
| (7.) The phosphoric acid bead, therefore, now weighed | 65.9 |
| (8.) A fragment of pure zinc was now attached to the warmed side of the bead (5), and the wire, bead, and zinc weighed | 134.3 |
| (9.) Therefore the fragment of zinc weighed .. | 8.3 |
| (10.) Weight of (8), after all bubbles of phosphuretted hydrogen had been eliminated by a gentle P.P., directed solely on the bead, not on the zinc\|\| .. | 128.0 |
| (11.) The clear bead without bubbles, therefore, now weighed, alone | 67.9 |
| (12.) And the loss of (8), caused by the operation described in (10), | 6.3 |

Phosphoric acid fused before the blowpipe is, I believe, called by chemists "Hydric metaphosphate, (2HPO₃), which formula (apparently) does not suffice to thus produce phosphuretted hydrogen—



Its atomic composition, however, is—



total weight = 160.

The atomic weight of zinc is 65.2, and, to determine the weight of the amount of phosphuretted hydrogen evolved by acting on hydric metaphosphate with 8.3 m.grms. of pure zinc, we have the ratio—

| At. wt. Zn. | M. grms. Zn. | H ₃ P. |
|-------------|--------------|--|
| As 65.2 | : 8.3 :: | 34.0 : x |
| 34 × 8.3 | | 8.3 |
| 65.2 | | 272.0 |
| | | 10.2 |
| | | 65.2) 282.2 (about 4 m.grms. H ₃ P evolved. |
| | | 260.0 |
| | | 22.2 |
| | | 18.6 |

But the decomposition of the whole bead, of 65.9 m.grms., of hydric metaphosphate could only have produced about 7 m.grms. of H₃P; whereas the residual bead, including loss by volatilisation, still weighed 67.9 (11), minus, of course, the weight of the "zinc phosphate," after 6.3 m.grms. of gas had been evolved. I would therefore submit that the hydrogen in this case appears to have been evolved by the zinc, and not by the hydric metaphosphate.

* Symbol P.P., vide "Pyrology," page 58.

† Vide "Pyrology," page 70, fig. 38.

‡ For oxyhydrogen pyrocone; the hottest "flame."

|| That no loss is occasioned by an imaginary volatilisation of zinc is proved by heating a bead of phosphoric acid containing a fragment of that metal on aluminium plate, even before a strong O.P., when, although an explosion takes place, and a beautiful yellow metallic colour is produced, there is no zinc sublimate, but a slight loss of phosphoric acid in the shape of minute balls projected over the aluminium.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;

Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 274).

AKIN to these are the processes for making size and glue. All sorts of gelatinous materials, as fresh English fleshings (cuttings of hides) from tanneries, kip fleshings from abroad, calves' pates, and the cuttings of skins called "hide pieces," dried sinews, sloughs (bones inside horns), with other such offal and garbage, as well as fresh bones, are the raw materials from which size and glue are made. The fresh fleshings, as well as the clippings of others which contain fresh lime, are steeped for several hours in water acidulated with sulphuric acid. Old fleshings, in which the lime is killed by becoming carbonate, are merely washed with water; and these with the other glue-making materials are put into large open boilers, "called glue-pans," with water, and are boiled for two or three hours by a naked fire, when glue is made, or by means of a steam coil, when size is the product, until they are dissolved. They are frequently stirred during this operation, in order that the fat may rise for collection. The liquid is then run off through a rough strainer into a tank, and allowed to settle for about half an hour, when it is either put into tubs and sent away as size, or it is allowed to set in wooden troughs, from which it is taken and cut up into blocks about a foot square, which are subsequently further divided by means of a wire into slabs and dried. The degree of concentration in making size is much less than that for glue, the point in the latter case being determined by the appearance of the cooked liquor upon a lump of alum. The residue in the glue pans is a mass of fibrous matter, called "skutch," which often contains enough fat to pay for another operation. The skutch is put into a boiler with enough sulphuric acid to dissolve the fibre (about 75 lbs. to a ton of skutch), and it is heated by high pressure steam blown into it. Under this treatment the fibre dissolves and so lets loose the fat, which rises to the surface. All these operations are offensive, and require to be managed with great care to prevent them from being a nuisance. The fleshings and other materials, for example, are frequently allowed to remain in heaps in hot weather until they putrefy, and the vapours from the glue pans and the skutch pans are exceedingly nauseous. It is proper, therefore, that the raw material should be used as quickly as possible or be kept in covered tanks, and the vapours from the covered pans should be conveyed through condensers or coolers, and thence to the furnace fires.

Manure Making.—Apart from the making of superphosphate of lime, which I shall hereafter describe, the manufacture of animal manure is frequently a frightful annoyance, from the circumstance that it is generally in the hands of small capitalists, who have very little regard for the health and comfort of the community. The raw materials are of the most heterogeneous character; as fleshings, breakings, and other refuse from tanners, felmongers, soap-makers, fat-melters, bone-boilers, glue-makers, &c., together with all sorts of waste from furriers, wool-spinners, hair-dressers, &c.; putrid fish, putrid flesh, and the offal of markets and slaughter-houses; all of which are indiscriminately used as the basis of animal manures; and these are treated in vats or boilers with sulphuric acid and steam—there being rarely much pro-

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

vision for the destruction or neutralisation of the offensive vapours. Occasionally the operations are conducted in closed iron cylinders set vertically; so that the charge may be dropped into them at the top and let out at the bottom. When full they are made tight and submitted to the action of high pressure steam (from 30 to 50 lbs.), which is blown into them for ten or twelve hours. In this manner the materials are perfectly disintegrated, and after standing for a few hours to cool the liquid portion, consisting of water and fat, are first run out through a tap at the bottom, and then the solid parts are removed. Apparatus of this kind can be worked without annoyance to the neighbourhood; but if the manufacturer prefers to mix his materials in his own way, it should be done in a close chamber or cylinder with revolving arms, and with a contrivance for carrying the offensive gases to the furnace fire. Other operations, as *fish drying* and *smoking*, and the *preparation of albumen from blood and eggs*, also deserve notice as requiring attention and cleanliness to guard against nuisances.

Animal Charcoal Burning.—This until lately was a great annoyance to the inhabitants of the neighbourhood in which sugar bakers reside. Formerly the bones were burnt in iron retorts set in a furnace without much precaution against the escape of the offensive empyreumatic vapours; and the red-hot charcoal was cooled and quenched in iron boxes by means of water, whereby much sulphuretted hydrogen was evolved. The processes, however, at present in practice are planned with every consideration for the public comfort. The retorts are so constructed that the vapours from the ignited bones are carefully conducted to the furnace-fire and are burnt; and the red-hot bone black is received into specially designed coolers that do not permit of the access of atmospheric air, which would be destructive of the carbon of the bones. When the animal charcoal has become exhausted of its decolourising power, it is again burnt and revived in revolving retorts, or in well-designed vertical cylinders, which do not permit of the escape of any offensive matter into the surrounding atmosphere, but discharge it into the furnace-fire.

The roasting of coffee, chicory, and cocoa, if not properly managed, is offensive. The operation is performed in a revolving cylinder or cage set over a coke or charcoal-fire enclosed in a tight chamber, which is ventilated to the chimney shaft. In the case of coffee and cocoa the roasting operation is often performed in wire cylinders; whereas that of chicory, on account of the large quantity of powder produced, is always of sheet-iron. The cylinders are about 4 feet long and 20 inches in diameter. They receive about a hundredweight at a charge, and they are run into the roasting chamber upon a square axle, which supports them over a clear fire about a foot above it. They are then set in gear, and turned by machinery at the rate of about fifty revolutions a minute. There are breaks in the interior of the cylinder to distribute the coffee or chicory during the roasting so as to equalise the action. The operation lasts about thirty or thirty-five minutes for coffee or chicory, and half the time for cocoa; and the empyreumatic vapours go into the fire and up the chimney shaft. When the operation is finished, in the case of coffee and cocoa, the roasted berries are cooled by a blast of air, and this blows about a quantity of the outer covering of the coffee berry (called flights), which are occasionally annoying to the neighbourhood. The loss of weight during these operations is from 14 to 16 per cent for coffee, from 9 to 11 per cent for cocoa, and about 25 per cent for chicory. *Brown malt* and *roasted corn* are likewise roasted in much the same manner, and require that the empyreumatic vapours should be carried into the fire and be burnt.

There is another vegetable matter which in burning has lately caused offence to the neighbourhood in which the operations are conducted. This is the resinous matter obtained by the evaporation of the alkaline liquor obtained in the treatment of *Esparto grass and straw in paper-*

making. The liquor is first evaporated in large close evaporating pans, which receive the full force of the fire above and below, and thus the vapours are carried forward into the chimney shaft. When the residuum is sufficiently consolidated it is roasted in a furnace for the purpose of burning off the organic matter and recovering the alkali. This operation has been forced upon the paper-makers in consequence of the difficulty of disposing of the spent liquors. The residuum of the evaporation would no doubt serve as a means of preventing scale or fur in steam boilers.

Within the last ten years a new branch of industry has sprung up in this country on account of the permission to use sugar as well as malt in the production of beer. The sugar is called *saccharine*, or *glucose*, or *grape sugar*, and it is generally made from the cheapest and most accessible kinds of starch. Rice starch is that which is commonly used in this country at the present time. The rice is crushed between rollers and macerated in a vat with a little alkali for about twelve hours, during which time it is constantly stirred by revolving arms moved by machinery. In this manner the gluten of the rice is dissolved out of it, and the starch is set free. After standing quiet for about six hours the starch settles, and leaves a supernatant solution of gluten, which is generally thrown away. The starch is then transferred to another vat and treated with water acidulated with sulphuric acid. About 150 lbs. of acid (sp. gr. 1.850) and 1500 gallons of water are sufficient for a ton of starch. The mixture is stirred like the last, and it emits a smell of rancid butter and grains (butyric and lactic acids). It is then run into a vertical cylinder called a "digester," where it is submitted to the action of steam, at 20-lbs. pressure, blown into it for about half an hour. This converts the starch into glucose, and the solution is allowed to flow into a vat, where it is neutralised with powdered chalk and kept stirred for about two hours, during which time the same offensive smell of butyric and lactic acids is evolved, and to a much greater extent. The clear liquor is next filtered through horsehair bags to separate sulphate of lime, after which it is evaporated *in vacuo* to the consistence of a very thin syrup, which is filtered through animal charcoal in the usual way. It is then further evaporated *in vacuo* until it looks like honey, and in this state it is poured into moulds and allowed to set. The yield of starch from the rice is as much as 80 per cent, and the yield of sugar is about 5 per cent above the weight of the starch. The saccharine or grape sugar, when well made, contains from 80 to 82 per cent of glucose, with only a trace of gum and mineral matter; and it is generally used by the brewer mixed with two parts of malt. The offensive effluvia from these operations are easily prevented by covering the vessels and ventilating them into the fire or chimney shaft.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 276.)

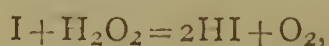
THE three last-named methods may be considered as adapted for industrial purposes. As the peroxide of hydrogen does not solidify at -30° its solutions may be concentrated by cooling them below 0° , and allowing the water to freeze out. For this purpose Houzeau makes use of the apparatus of Carre.† A great difficulty in the

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

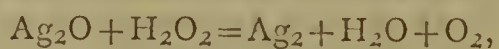
† Houzeau, *Monit. Scient.*, 1868, 175.

way of the commercial preparation of peroxide of hydrogen lies in its instability. This substance requires to be preserved in well-closed vessels and in acidulated solution, and even thus it requires great caution. Wood-charcoal and certain oxides and metals, especially silver, gold, and platinum in a state of fine division, decompose it by mere contact.

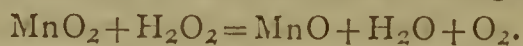
That it is a powerful oxidising agent, and that it even in the cold converts arsenious into arsenic acid, sulphide of lead into sulphate, and the lower oxides of manganese, iron, cobalt, barium, strontium, and calcium into the highest oxides of these metals, and that it at once completely oxidises arsenic and other elements, is not remarkable. But the more interesting and surprising are the observations of Thenard, extended and explained by Brodie in 1850, and shortly afterwards of Schönbein, according to which the peroxide of hydrogen acts not merely as an oxidiser, but as a powerful reducing agent; that it converts iodine into hydriodic acid,



that it separates metallic silver from silver oxide,



and reduces peroxide of manganese to manganous oxide,

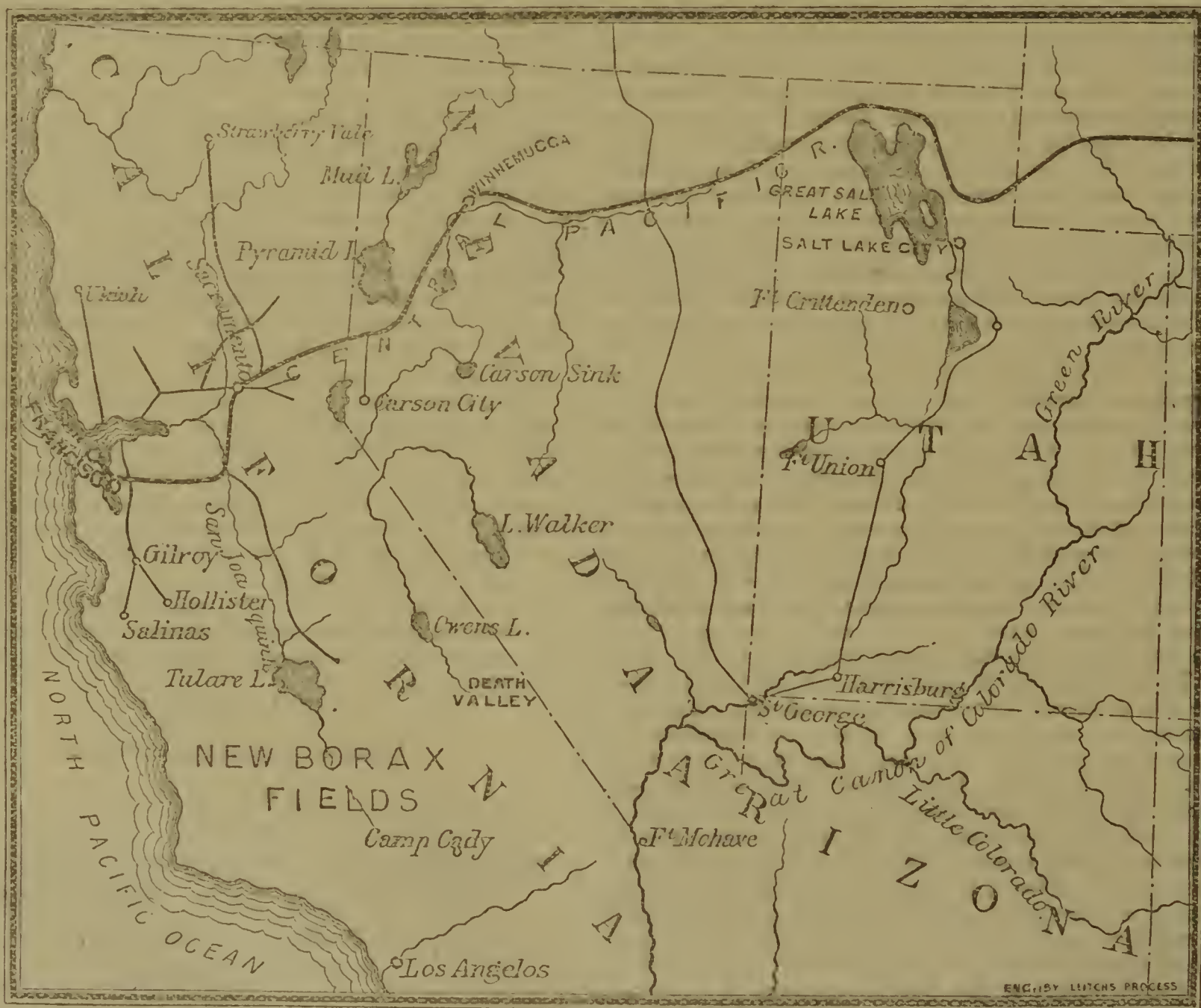


deep blue by perchromic acid, but soon (especially if no ether is present) oxygen escapes and green solution of chloride of chromium remains. Similarly both actions appear simultaneously when solutions of ferrous sulphate and indigo are mixed with peroxide of hydrogen. The ferrous oxide is transitorily peroxidised and then again reduced, whilst the oxygen is transferred to the indigo and decolourises it.

By these effects of oxidation and reduction, both of which it displays in the highest degree, the industrial sphere of the peroxide of hydrogen is marked out. These effects, although mutually antagonistic, answer the same purpose for a certain practical operation, *i.e.*, bleaching sulphurous acid and zinc-powder, powerful reducers, as well as chlorine and ozone, powerful oxidisers, are all used as bleaching agents. How much the rather can this function be assigned to peroxide of hydrogen?

BORAX.

THE trade in borax is likely to undergo considerable modifications in consequence of Mr. Arthur Robottom, of Birmingham, having found deposits of crude borate of soda at the bed of a dry lake in the Slate Range Mountains.



In these reactions two atoms of oxygen coalesce to one molecule, which explains this strange phenomenon. At times peroxide of hydrogen acts almost simultaneously as an oxidiser and a reducer. Thus it converts chromic acid, CrO_3 , transitorily into perchromic acid, which is very soon resolved into chromic oxide and free oxygen. If we, therefore, add to peroxide of hydrogen a few drops of a solution of chromate of potash and a little hydrochloric acid, and shake up with ether, the latter is coloured a

The position of the district may be seen from the map. The following description appears in the *California Alta* :—

“Beyond the Sierra Nevada, in the enclosed basin of North America, about 140 miles in a north-eastward direction from Bakersfield, there is the bed of a dry lake

* For the use of this woodcut we are indebted to the Editor of *British Mercantile Gazette*.

filled over an area of 15 miles long by 6 wide with saline crystals to a depth of about 6 or 8 feet. The appearance of the surrounding country clearly indicates that water once stood 60 feet deep here over a large area, the ancient beach being distinctly traceable. The most remarkable fact about this saline product is that in its middle there is a tract 5 miles long and 2 wide of common salt, while on the outside there is a deposit of borate of soda 3 feet thick, and under this a lower stratum composed of sulphate of soda and tincal mixed together from 1 to 3 feet thick. These minerals are all in crystals, the sulphate of soda and tincal forming a solid mass, almost like stone in its hardness. The borate of soda is of a dirty hue, but the salt, which lies above the level of the entire deposit, in some places to a depth of 7 feet, is white as snow. The report of natural deposit thus situated will appear very improbable to scientific men, for there is nothing to account for the separation of the salt from the borates, or for the accumulation of salt above the level of other crystalline deposits. We have Mr. Robottom for authority, and the country is open for those who wish to examine for themselves. The place can easily be found. It is known as the Borax Fields in the Slate Range, and will be examined carefully by many competent men, since the tincal—a crude borate of soda—is a valuable mineral, and can be separated at little expense from the sulphate of soda. Mr. Robottom brought samples of the minerals along, and has shipped some of the tincal to England believing it can be obtained at less price than from Thibet, and of equally good quality. It is the most valuable borate mineral yet found on our coast, preferable for shipment to any of the borates obtained in Nevada, whereby the deposits are mainly borates of lime and soda. The Californian tincal can probably be used without refining for glazing fine pottery; and if so, it may drive the Thibetan tincal out of the market. Only time can determine which of California, Nevada, Thibet, Tuscany, Peru, and Chili—the principal producers of borax—can undersell the other. Tincal has not yet been found in Nevada, but it probably exists in several of the dry lake beds in the south-eastern part of this state. The deposits of borate of lime and borate of soda are numerous.”

In May of the present year the men working at the lake informed Mr. Robottom that no rain had fallen since he was there in 1874. He says the men do not work much at the under surface, for they find the crude borate of soda that lies on the surface is easily crystallised, and on exposure of the crystals to the sun after they are taken out of the vat a white powder is obtained which is preferred by some of the potters to the refined borax of the English market. The following is an analysis of a sample of this Slate Range borax :—

| | |
|--------------------------------------|--------|
| Crystallised bi-borate of soda | 99.75 |
| Chloride of sodium | 0.25 |
| | 100.00 |

For cleaning purposes it is far more economical and possesses great advantages over common soda and washing powders. On the occasion of his last visit to the district Mr. Robottom found a dead horse which had been left in a very thick deposit of the crude borate of soda. It had been there for more than four months, yet no offensive smell proceeded from it, although the thermometer stood at from 106° to 115° in the shade. The hair appeared to be quite firm on the skin.

The cost of transporting the borate of soda is being considerably reduced, so that prices will probably be much lower than at present.

Saccharification of Amylaceous Matters.—M. L. Bondonneau.—In all saccharification there are formed three products soluble in water, incapable of reducing alkaline solutions of copper, and capable of entire transformation into glucose by hydration—properties characteristic of the dextrins.—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 11th, 1875.

Professor GLADSTONE, F.R.S., President, in the Chair.

THE following candidates were elected Members of the Society :—C. Higgins and S. O. Thompson, B.A., B.Sc.

In the absence of Prof. G. C. Foster, Mr. LODGE exhibited and described a simple form of chronoscope for measuring short intervals of time, which Prof. Foster has recently devised. In experiments commenced about eight years ago, the apparatus consisted essentially of three parts—(1) An arrangement for releasing the bullet or other body whose fall was to be timed, when the apparatus is employed for such determinations; (2) an arrangement for directing a gauged stream of water into a vessel during the time occupied by the fall of the body; and (3) a platform to receive the falling body. The stream of water was directed into the vessel by means of a bent funnel brought under the constantly flowing stream by an electro-magnet. But this apparatus had two serious defects, one of which was caused by the difficulty of accurately gauging the stream, and the other by the inertia, and consequent sluggishness, of movement of the funnel. The arrangements, however, for dropping and receiving the bullet, being satisfactory, were finally adopted. The former is simply a clip, one side of which is a spring, and this forms the armature of a small electro-magnet. On completing the circuit the spring is drawn aside and the bullet released, momentarily breaking a current which passes through it, as subsequently described. The bullet, at the end of its fall, strikes a small mahogany table, so arranged that the blow slightly depresses it, and permanently breaks the same current, which in the interval has been closed by a subsidiary wire. The author abandoned the method of indicating the commencement and end of the fall by an independent electro-magnet, and substituting the trace made on blackened paper by a vibrating tuning-fork for the stream of water, he registered them by perforations made by induction-coil sparks in the blackened paper, a method suggested by the description of Beetz's chronoscope. The apparatus is difficult to describe without the aid of diagrams, but the following will perhaps sufficiently indicate the general arrangement:—The two terminals of the secondary coil are connected, the one with the tuning-fork, and the other with the metallic drum on which the blackened paper is carried. The other connections are as follows :—The current passes from one pole of battery to spring of releasing apparatus (which is also connected with one terminal of a separate condenser), thence through the bullet to the fixed portion of the clip and by a wire to the lower table, which is also in electrical connection with the face of the electro-magnet which releases the bullet, in order that the current may be completed immediately the falling body is released. From this table the current passes through an adjusting screw to one terminal of the primary wire of the induction coil which is connected with the other condenser terminal. The other pole of the battery is connected with the primary. The spark in each case is caused by the breaking of the current, which takes place when the bullet is released, and when it strikes the table, the perforations in the black paper of course being made in the trace produced by the tuning-fork. It is hardly necessary to mention that the releasing electro-magnet is worked by one or two independent cells. The author considers that with a fork making sixty-four complete vibrations in a second the error, in determining an interval of not more than two or three seconds, should not exceed 1-500th of a second, and that, with a more rapidly vibrating fork, probably much greater

accuracy might be obtained. Mr. Lodge made four experiments before the Society, with falls of 2 feet and 1 foot, from which the value of gravity was found to be 32.21.

Prof. GUTHRIE inquired whether the instrument was sensitive to the influence of temperature on the time of vibration of the tuning-fork.

Mr. LADD suggested that the pressure of the marker on the end of the tuning-fork might hinder its vibration, and referred to difficulties which Captain Noble had met with in the working of his chronograph.

Mr. LODGE stated that experiments had only been made in a laboratory having a fairly equable temperature, and that therefore the effect of considerable changes of temperature had not been ascertained. He considered that the slight resistance referred to by Mr. Ladd would rather tend to diminish the amplitude of the vibrations than to change their number per second.

Prof. McLEOD then described and exhibited an arrangement for ensuring that the charge given to a Leyden jar shall not exceed any fixed limit. Through a cork in the upper end of a bell-glass passes a brass rod, insulated through its entire length by means of a glass tube through which it passes freely. To the upper end is attached a brass knob, and the lower end is pointed and provided with a screw-thread, so that it can be set at any distance within, or through a hollow brass ball, perforated below, and rigidly fixed to the glass tube. Within the bell-glass is a loose cage of perforated sheet zinc, and a vessel containing strong sulphuric acid. The whole stands on a metallic plate to secure a good earth connection. The action is as follows:—If the rod be screwed down so that the point projects through the hollow ball, the upper knob and lower metallic plate being connected with the two poles of a Holtz machine, only short sparks can be obtained, because a large amount of electricity escapes at the point, but if the rod be raised so that the point barely enters the hollow ball at the top no escape takes place from it, and the machine will give its full length of spark. By varying the position between these two extreme limits, any required length of spark, or amount of charge for interposed Leyden jars can be obtained.

Mr. C. F. VARLEY thought the method useful for roughly approximating to the required tension. He mentioned that the length of a spark between two balls or points is no accurate measure of tension, and referred to the experiments of Faraday and Sir W. Thomson.

Prof. McLEOD explained that the instrument was in no way intended as a measure of electricity, but only to ensure that the charge obtained should not be excessive.

BRITISH PHARMACEUTICAL CONFERENCE.

Meetings of the Executive Committee, chiefly to entertain applications for grants of money in aid of chemical and pharmaceutical research, have been held on the first Wednesdays in November and December, in the rooms of the Pharmaceutical Society of Great Britain (by the kind permission of the Council of that Society), at 17, Bloomsbury Square, London. Present—Professors Redwood and Atfield, Messrs. Frazer, Groves, Hill, Schacht, and Williams.

After the confirmation of the minutes of the previous meeting, which included a resolution raising the salary of the editor of the Conference "Year Book" from £100 to £150, the following applications for grants were read, several being sent in response to requests or suggestions from the Committee:—

1. From Mr. A. W. Gerrard, £10 to cover cost of extraction of pilocarpine from *jaborandi*, with a view to its further chemical and pharmaceutical investigation.

2. From Dr. C. R. A. Wright, £20 to defray expenses in connection with the extended researches on the aconitines. Respecting this application Messrs. Hopkin and

Williams had stated that they would gladly furnish Dr. Wright with concentrated extracts of the raw material for the mere cost.

3. From Mr. M. M. Pattison Muir, £5, with which to purchase the required quantity of essential oil of sage for a research.

4. From Mr. C. T. Kingzett, £10 to pay a portion of the cost of materials necessary for continued researches on the oxidation of essential oils.

5. From Mr. E. L. Cleaver, £10, with which to purchase opium for a thorough examination of the methods of ascertaining the proportion of morphia in the drug, and a report on a trustworthy mode of assaying opium.

6. From Mr. R. H. Davies, £5 to defray part of the cost of an investigation or the definite proximate principles of ivy berries.

7. From Dr. H. E. Armstrong, £10 for the purchase of strychnine with which to conduct a research on the oxidation products and bromo-derivatives of that alkaloid.

8. From Dr. W. A. Tilden, £5 to be expended in carrying on further investigations of the aloins.

Total number of applications, 8; total amount of money grants, £75.

On the motion of the President, it was resolved unanimously to grant to the gentlemen named the sums mentioned, to thank them for undertaking the several researches, and to request them to communicate results to the next general meeting of the Conference at Glasgow, on Tuesday and Wednesday, the 5th and 6th September, 1876.

The Honorary Secretary reported that since the meetings of the Committee in August he had received nearly 560 subscriptions of 7s. 6d. each from that number of members, all of which sums had been duly acknowledged and placed to the credit of the respective members. The number of members up to December was about 2800.

The Treasurer was ordered to invest in consols £200 of the balance in his hands, pending the consideration of the best mode of dealing with surplus income.

The Secretaries announced that the "Year Book" for 1875 was in type, that it would extend to six hundred and fifty pages, that it would be published on or about the 11th of December, and that a copy would be sent post-free to every member who had paid his annual subscription (7s. 6d., by P.O.O. payable at the High Holborn office to Professor John Atfield, Hon. Gen. Sec., 17, Bloomsbury Square, London, W.C.).

A letter was read from a member suggesting that the Conference should nominate, in connection with the Cambridge University Extension Scheme, a travelling Professor of Pharmacy, who should lecture in the provinces at different centres, and that the Conference should contribute towards his remuneration £150 per annum. After thoroughly discussing the proposal, the Committee were unanimous in the opinion that at present it would be unwise to include the great subject of education among the objects of the Conference. The Conference had been for the thirteen years of its life recognised as a body devoting its whole strength and resources to the prosecution of original research in connection with pharmacy, by issuing lists of subjects for investigation, publishing a "Year Book" of researches made at home and abroad, and granting money in aid of research; and, secondarily, by holding annual gatherings of members for friendly intercourse, as well as for the reading and discussion of the original papers. Support could not be awarded to any particular scheme of education without full consideration of the whole subject, and the latter could not be entertained with the probability of the Conference taking any important action in the matter without enlarging the organisation of the Conference and extending its work to areas already occupied by other societies. The Committee concluded that they were only anticipating the wishes of the members in declining to entertain the consideration of any plan of direct pharmaceutical education.

MANCHESTER LITERARY AND PHILOSOPHICAL
SOCIETY.

Ordinary Meeting, November 2nd, 1875.

R. ANGUS SMITH, PH.D., F.R.S., &c., Vice-President, in
the Chair.

PETER SPENCE, F.C.S., &c., exhibited a piece of 2 to 3 inch lead pipe in which the metal had been entirely transformed into galena, the crystallisation being visible through the whole of the specimen.

The shape of the lead pipe was unaltered, showing that the lead had not been exposed to a melting heat; no increase of bulk was visible, but the pipe was so brittle as to shiver with a blow. The circumstances in which this change was effected, as nearly as can be made out, were as follows:—

The pipe had been used for the conveyance of gas ammoniacal water, and was sunk under ground. It was in the vicinity of a furnace which heated the ground where it lay. It had been disused for some years, but never taken up. When the ground where it lay had to be excavated for a new erection it was found that there had been a considerable leak of gas water, as the ground for some space was impregnated with ammoniacal salts. About 25 per cent of the ammonia in gas water being sulphide, and the ground being warm, a constant atmosphere of sulphide of ammonium would surround the pipe, and this seems to have been the cause of the conversion of the lead into sulphide, as only that part of the pipe which was in the vicinity of the leak was found to be transformed.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

JOHN PATTINSON, President, in the Chair.

PRESIDENT'S ADDRESS.

(Continued from p. 279.)

AMONGST the improvements which have recently been made in what may be described as the auxiliary processes of the Le Blanc method of soda-making, Mr. Hargreaves's invention stands out as one of the most radical and important. It has not yet been set to work in our district, but the Jarrow Chemical Company, I understand, are nearly ready to commence the plant they have been erecting. Mr. Hargreaves informs me that about 400 tons of sulphate of soda per week are now produced by the direct action of sulphurous acid on common salt in the Lancashire district and in Ireland. In addition to this, the plant being erected and preparing to start is equal to a further production of about 550 tons of sulphate of soda per week. I understand that one of the practical difficulties of this process consists in obtaining the salt in a suitable mechanical condition so that gases may penetrate every portion in the cylinders. The temperature also requires very careful regulation. The heat must be high enough, on the one hand, to enable the chemical changes to take place, whilst on the other it must not be so high as to melt the contents of the cylinders. The uniform rate at which the hydrochloric acid is evolved enables the condensation of this gas to be easily effected. Mr. Hargreaves says that 99.9 per cent of the total acid evolved is condensed,

Lawes's Chemical Manure Company have experimented with Dr. Sprengel's patented improvements in the manufacture of sulphuric acid, and, it is said, with marked success. Dr. Sprengel's process consists in injecting into the chambers a great portion of the necessary water in the form of spray instead of steam. The spray is produced by means of a jet of steam issuing at a pressure of about 30 lbs. into the centre of a flow of water. These jets are introduced in the sides of the chambers at intervals of about

40 feet. The apparatus is inexpensive, and it is said the saving of fuel, acid, nitre, and labour, during the three months the process had been at work, amounted to about 5s. per ton of acid of 1.600 specific gravity. If these statements are borne out, and there are no counterbalancing disadvantages in the process, we shall, doubtless, soon hear of its being in use on the Tyne. Dr. Sprengel tells me that he is already introducing it into six different works in other districts.

An apparatus for concentrating sulphuric acid has been devised by Messrs. Faure and Kessler, of the Clermont-Ferrand Chemical Works, in France, which appears to have advantages over the old processes in point of cheapness of first cost and economy of working. The concentration is made in flat, shallow, dish-shaped vessels, made either of platinum or porcelain. The dishes are covered by a leaden dome or chamber, which is contrived to condense the acid fumes evolved and to conduct them into the leaden chamber. The cost of evaporation is said to be reduced one-half. It appears this apparatus has been adopted in about twenty chemical works in various parts of the world. It has not yet been used on the Tyne.

A marked improvement has, I think, been made in the apparatus for decomposing salt, by Messrs. Jones and Walsh, of the Middlesbro' Chemical Works. Instead of the ordinary decomposing pan and finishing furnace, Messrs. Jones and Walsh substitute a flat-bottomed circular pan, about 14 feet in diameter, having a rim about 6 inches deep, in which the process of decomposition by sulphuric acid is begun and finished. The pan is furnished with a mechanical stirrer, which consists of a vertical axle resting in a footstep in the centre of the pan, having horizontal arms carrying scrapers and rakes. The stirring arrangement is made to rotate by suitable driving gear. The pan rests upon solid brickwork, and it and the mechanical stirrer are enclosed by arched brickwork. The necessary heat is derived from a coke fire, and passes over the surface of the batch, the products of combustion passing on with the evolved hydrochloric acid to the condenser. No heat at all is applied to the bottom of the pan. The furnace is charged with 40 cwt. batches of common salt and the necessary amount of sulphuric acid, and one of such batches is finished every six hours. Larger batches could be worked in the same-sized pan, if more powerful driving gear than has been used hitherto in the experimental furnace were applied. The wrought-iron work of the mechanical stirrer is not at all, or but very slightly, acted on by the acid, and the only parts it has been found necessary to renew during the three months the furnace has been at work are the scrapers, which appear to be worn by mechanical and not chemical action. The sulphate of soda formed is very uniform in quality, and is in a fine powdery condition, quite free from lumps. One of the advantages of this process is that the composition of the batch is entirely under control. Shortly before it is finished a sample is taken and tested for chlorides and free acid. If either is in excess, this is corrected at once by introducing a little more salt or sulphuric acid, as the case may be, and the batch made of the required composition before it is drawn from the furnace. There are no "fluxings" in this process, the bed of the furnace being kept quite clean by the action of the scrapers. I have made an analysis of the sulphate of soda, and find it contains as follows:—

| | |
|--------------------------------|-----------------|
| Sulphate of soda | 97.87 per cent. |
| Sulphate of lime | 0.92 „ |
| Chloride of sodium | 0.53 „ |
| Silica and peroxide of iron .. | 0.47 „ |
| Water and free sulphuric acid | 0.21 „ |
| | 100.00 |

The cost of the furnace is much less than the cost of the ordinary pan and furnace, and the cost of labour is about one-half of that of the ordinary process. It is unnecessary that the labour should be skilled. The fuel used is

also less than in the pan and furnace of the ordinary process. There is, I think, some danger of the products of combustion interfering with the perfect condensation of the hydrochloric acid; but Messrs. Jones and Walsh tell me that they have no difficulty on this score, and that the gases of the chimney into which this furnace, as well as the other furnaces in their works draft, contains only from 0.010 to 0.015 of a grain of acid per cubic foot. Should the process work satisfactorily in this respect, I think there is no doubt that this is an important improvement in the decomposing plant of our chemical works.

Mr. James Maclear has recently patented some improvements in the manufacture of soda and potash which are now carried out at the St. Rollox Works, in Glasgow, and also in some works in Lancashire. Mr. Maclear's invention is applied chiefly to the charge in the revolving ball-furnace (which, by the way, is now steadily superseding the old hand-furnaces throughout the country), and consists in adding a small quantity (from 3 to about 10 per cent) of caustic lime to the mixture of sulphate of soda, coal, and carbonate of lime, at or near the end of the reaction. He recommends that the ball mixture at first placed in the furnace should contain carbonate of lime barely in excess of the chemical equivalent required. The advantages of this process are said to be that the ball soda dissolves readily; that the proportion of carbonate of lime being diminished, a much increased quantity of sulphate of soda may be decomposed in a furnace of a given size; that the time occupied in finishing each charge being reduced, an increased number of charges can in most cases be worked in a given time; and that there is a great saving of coal and carbonate of lime.

(To be continued.)

CORRESPONDENCE.

THE RIVERS' COMMISSION.

To the Editor of the Chemical News.

SIR,—The following occurs on page 505 of the Appendix to the Sixth Report of the Rivers' Commission:—

| | Sulphate of Quinine Taken. | Nitrogen Calculated. | Nitrogen Found. |
|---------------|----------------------------|----------------------|-----------------|
| Expt. I. .. | 1.95700 | 0.100 | 0.0996 |
| Expt. II. .. | 0.97850 | 0.050 | 0.0470 |
| Expt. III. .. | 0.09785 | 0.005 | 0.0060 |

And these quantities of sulphate of quinine do *not* contain the quantities of nitrogen which the Royal Commissioner, Dr. Frankland, thus represented them as containing. Dr. Frankland cited these experiments as establishing the validity of his process of water analysis; and I have remarked that what they really do show is that Dr. Frankland's process gives results in accordance with the expectation of the analyst, and not with the composition of the sample.

To this Dr. Frankland has made a very curious reply. He denies that he really used the above quantities of sulphate of quinine in the above experiments, and says that on reference to the label on a bottle in his possession he can now affirm that the quantities really employed were 1.5572, 0.7786, and 0.07786. He also offers some explanation of the way in which he came to say, in the Report, that he had used 1.957, 0.9785, and 0.09785. I cannot offer any suggestion as to the light in which this explanation should be viewed, and will content myself with recording it as simply as possible, only adding that Dr. Frankland's statement that he calculated the sulphate of quinine by a wrong formula is borne out by another reference to sulphate of quinine on page 506 of the Report, where 0.02 gramme of sulphate of quinine is affirmed to contain nitrogen equivalent to 0.00128 gramme of ammo-

nia. In this last case the calculation (which is a miscalculation) is of very long standing, having been made by Dr. Frankland in the year 1868, and being merely reproduced in the Report of the Rivers' Commission.

I have now to criticise the experiments on sulphate of quinine, assuming the correctness of the explanations given by Dr. Frankland and Mr. Thorp, who, as it would seem, made the experiments in question. The sulphate of quinine ought not to have been taken hydrated, but carefully dried. Of this Mr. Thorp appears to be partially, but only partially, sensible. He is, as his letter shows, at great pains to prove that whether hydrated sulphate of quinine contains 7, $7\frac{1}{2}$, or 8 atoms of water of crystallisation makes no sensible difference in the percentage of nitrogen; but he altogether overlooks the difficulty which arises from the extreme instability of the hydrated compound, which, indeed, gives up its water at ordinary temperatures if only the air in contact with it be dry. For anything that Mr. Thorp knows to the contrary, his sulphate of quinine, which he is pleased to regard as combined with some 15 per cent of water of crystallisation, may have contained only 5 per cent of water: and, accordingly, when he imagined he was dealing with 0.100 of organic nitrogen, and obtained experimentally 0.0996 of nitrogen, he may have been dealing with 0.110 of nitrogen. Thus, conceding to Dr. Frankland and Mr. Thorp the explanations which they have furnished after the objections to the Report of the Royal Commissioners have been pointed out to them, the sinister correspondence between expectation and result still remains, although not in so striking a form.

The extreme gravity of this "sulphate of quinine episode" may be judged of when it is considered that these experiments are the only evidence, or semblance of evidence, as yet offered by Dr. Frankland in favour of the validity of the process of water analysis which, in his capacity of Royal Commissioner, he has employed—and employed exclusively—in the very important investigations which the Crown had commissioned him to undertake. His method of water analysis, as is notorious, has met with general condemnation at the hands of chemists; and, with the sole exception of these experiments on sulphate of quinine, everything that he has published concerning his process has been a demonstration of its utter untrustworthiness and impracticability.—I am, &c.,

J. ALFRED WANKLYN.

LIVERPOOL SODA TESTS.

To the Editor of the Chemical News.

SIR,—I was glad to see that Mr. Pattinson has called the attention of the Newcastle Chemical Society to the discrepancy between the reports of Liverpool chemists and those in other parts of the kingdom on the examination of alkalies. It has been, and is, the constant source of annoyance to many analysts, and myself amongst the number.

During the past year I have been several times called upon to report on samples of soda-ash against a Liverpool chemist, and my result has been invariably lower than his. In fact I have found it necessary, in order to avoid misunderstanding here, to report result in three distinct forms:—

- (1.) Per cent real soda.
- (2.) Per cent commercial standard.
- (3.) Probable test in Liverpool.

I think that the existence of a commercial standard, in contradistinction to the actual percentage of soda, is a disgrace to our analytical system, and would long since have been done away with were it not that the greater number of analysts interested in the matter are employed by manufacturers, to whom the retention of the old equivalent of sodium is an advantage.

Upon enquiry in Liverpool I found that it is the custom that the analyst shall report only whole numbers, so that a soda-ash containing under $49\frac{1}{2}$ is reported 49 per cent, and over $49\frac{1}{2}$ per cent is reported 50 per cent. Therefore the probable test in Liverpool is the amount of soda according to commercial equivalent, with sufficient added to make it a whole number. The various reports on the same sample of soda-ash well illustrate this:—

| Sample Soda Ash. | | Commercial Test. Per cent. | Real Soda. Per cent. |
|------------------|--------------------------------|-------------------------------|-------------------------|
| Same sample { | Seller's chemist, Liverpool .. | 55.00 | — |
| | Buyer's chemist | 53.00 | — |
| | My own report | 52.68 | 52.00 |
| | Another Manchester chemist | 52.54 | 51.82 |

Of course if we followed the practice of doing away with decimals we should report 53 per cent.

I have also examined the sample taken from another lot by the analyst's *employés*, and have compared it with samples taken from the same lot by the buyer's men, with result as follows:—

Sample taken by seller's chemist—

| | Commercial Test. Per cent. | Real Soda. Per cent. |
|---|-------------------------------|-------------------------|
| His report | 51.00 | — |
| My own report | 50.00 | 49.4 |
| Sample of same lot taken by myself | 48.83 | 48.2 |

There is, unquestionably, great care required in taking samples, especially of soda-ash, which is lumpy; but beyond the error possibly introduced in this way there seems to be another, even greater, produced by some unexplained difference in the method used by the seller's analyst in Liverpool from those of analysts in other towns.

This is a state of things that should no longer be tolerated, and I doubt not that a thorough examination of the case would lead to the adoption of a universal true standard and correct method—an extremely desirable result, not only regarding the alkalies, but also other substances used in large quantities in the various chemical manufactures.—I am, &c.,

GEO. WARNER, F.C.S.

Ardwick Bridge Chemical Works, Manchester.

TESTING SODA-ASH.

To the Editor of the Chemical News.

SIR,—I am pleased to find that "A Soap-Maker" has again called attention to the discrepancies in trade analysis.

With regard to the testing of soda-ash all the text-books I have consulted take the combining number of soda as 31, and not 32 (old notation), and recommend the test-acid to be made of such a strength that each cubic centimetre shall equal 0.031 grm. NaO.

Then suppose 2 grms. of the ash to have been taken, and 31.3 c.c. of the test-acid used, the true percentage of soda or total alkali would be 48.5, and not 50 per cent, as the maker's analyst—who uses 32 for soda—would return it.

Being a novice in analytical chemistry I am open to correction as to these figures.

Now, if my memory serves me, an "ash" of 50 per cent was selling at 11s. per cwt.—that is to say, at $2\frac{1}{2}$ d. for each unit of strength per cwt. Consequently, in the above instance, supposing a delivery of 20 tons to have been made, the value of the difference between 48.5 and 50 per cent on the lot would amount to £6 5s.

A friend of mine tells me that he has had many such tests made, and has found them to be fully worth the price paid for them; for even supposing that he did not make a claim on the manufacturers, it is of the highest

importance to him that he should know the exact strength of his chemicals, in order to avoid waste.

It is said by some that buyers of "soda-ash" are quick to their own interests, and that they understand the "Liverpool test," as it is called, very well.

I hold in my hand a certificate of soda-ash which runs thus:—"We find the sample of soda-ash to contain of real alkali, as indicated by the burette, — per cent." Now I expect that many soda users do not know a burette when they see one; but even when its uses have been explained to them it may occur that its indications must, to a very considerable extent, be governed by the strength of the test-acid it contains.—I am, &c.,

NATRON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 10, November 20, 1875.

On a Very Sensitive Reagent for Detecting the Sulpho-Carbonates of Monosulphide (MS, CS_2) in Solution.—M. A. Mermet.—The reagent in question is the nickelate of ammonia. To make the test a drop of a solution containing $\frac{1}{10}$ of a pure salt of nickel (sulphate or chloride) is put in a test-tube with an excess of ammonia, and water enough to decolourise the liquid. A few drops of the solution in question is then poured in, when, if the smallest trace of sulpho-carbonate is present, a characteristic gooseberry-red colour is produced. If solutions of hepar are substituted for the monocarbonate a yellow tint is produced. Alkaline monosulphides give a brown or black according to the state of concentration; the sulpho-carbonates of bisulphide (MS_2, CS_2) (Gélis) give also a yellow.

Reactions for Distinguishing the Sulpho-carbonates of the Monosulphide MS, CS_2 , from those of the Bisulphide, MS_2, CS_2 .—M. A. Mermet.—If the reagents mentioned in the last notice are applied in a state of great concentration, and if the sulpho-carbonate is poured into an excess of the nickelate of ammonia, the results are as follows: Sulpho-carbonate of the monosulphides; a fine violet precipitate: sulpho-carbonate of the bisulphide; a yellowish brown precipitate.

On Certain double Metallic Sulpho-carbonates.—A. Mermet.—The author has isolated crystals of the double sulpho-carbonate of potassium and nickel.

On a Compound of Platinum, Tin, and Oxygen Analogous to the Purple of Cassius.—MM. B. Delachanal and A. Mermet.—Previously noticed.

Facts Relative to the Study of the Polyatomic Alcohols, Properly so-called. Application to a New Method of Obtaining Crystalline Formic Acid.—M. Lorin.—Already noticed.

Manner of Decomposition of Explosive Bodies Compared with the Phenomena of Supersaturation. MM. P. Champion and H. Pellet.—Already noticed.

Use of Fehling's Liquor.—MM. P. Champion and H. Pellet.—Recent experiments show that the standard of this liquid, which, in its normal state, does not change when used directly with a solution of glucose, undergoes, nevertheless, a certain modification which seems to be proportional to the time of keeping, when it is titrated with stannous chloride after the action of glucose (Weil's process).

On the Sulphides and Phosphides of Copper.—MM. P. Champion and H. Pellet.—The bisulphide is obtained

by leaving for several weeks copper turnings in contact with a solution of sulphur without bisulphide of carbon. The black precipitate obtained by adding a solution of the pentasulphide of potassium to a dilute solution of sulphate of copper yields the bisulphide on treatment with bisulphide of carbon. Proto-phosphide, Cu_2P .—The commercial proto-phosphide contains only 20 per cent of phosphorus instead of 32.8. The true proto-phosphide is obtained by adding this substance to an excess of neutral red phosphorus, mixing intimately, and heating to dull redness.

Decomposition of the Iodide and Chloride of Nitrogen.—MM. P. Champion and H. Pellet.—Already noticed.

Nitrocitric Acid.—MM. P. Champion and H. Pellet.—Nitrocitric acid is insoluble in ether, but soluble in alcohol in every proportion. If treated with anhydrous alcohol and gaseous hydrochloric acid it seems to give rise to the corresponding ether. Its formula is—



Nitrostearic acid corresponds to the formula—



Notices.—By M. Eug. Durrwell.—Light acts upon a solution of iodide of potassium and sugar. Such a solution if kept in a white glass bottle soon grows yellow. If starched papers are prepared in the dark and steeped in this solution, and exposed to light under a negative proof, a positive is obtained, which only need be washed in plenty of water to stop the further action of the light.

Dinitro-naphthalin prepared by boiling naphthalin with fuming nitric acid always contains much mononitro-naphthalin which must be eliminated by means of alcohol. If fuming nitric acid is distilled with a mixture of naphthalin and broken glass the reaction is complete.

The ash of the best qualities of tobacco is white, consisting to a great extent of salts of soda and potash. During combustion these salts swell up, rupture the fibres, and render the combustion complete.

A good method of treating the Alfa fibre is as follows: Steeping; passing through lime water; washing; reduction to the state of tow between fluted rollers; bleaching with chloride of soda.

On Dichlorethylamin.—M. J. Tschermak.—To prepare this substance the author distils hydrochlorate of ethylamin with chloride of lime, obtaining a very fluid oil, which passes over entirely between 75° and 95° .

Correspondence from St. Petersburg (September 1, 1875).—M. W. Louguinine.—The fifth number of the *Journal de la Société Chimique Russe* contains the account of the session of the Society of April 3 (15).

M. Zinine announced that, by heating oxylepiden, $\text{C}_{28}\text{H}_{20}\text{O}_2$, with alcohol and caustic soda it is transformed into its isomer, octahedric oxylepiden.

MM. Beilstein and Kourbatoff announce that the $m\text{C}_6\text{H}_3\text{Cl}(\text{NO}_2)_2$ yields $\text{C}_6\text{H}_3\text{Cl}(\text{NO}_2)\text{H}_2\text{N}$ in the shape of yellow needles, fusible at 124° to 125° .

M. Mendeleef, on behalf of M. Setschenoff, described his experiments on the absorption of CO_2 by saline solutions.

M. Wladowski gave the result of his experiments on the use of SO_2 in the production of brandy from grain. He does not confirm the opinion that this gas facilitates the conversion of starch into glucose.

M. Alexeef described his experiments on the solubility amylic alcohol in water at different temperatures.

M. Wroblewsky discussed the constitution of the derivatives of benzin.

M. Menschoutkine, on behalf of M. Barsilofsky, described a new nitro-derivative of toluen.

On behalf of M. Schihoutzky he communicated the result of researches on the azo compounds obtained on setting out from dinitro- and iso-dinitro-phenyl.

On behalf of M. Remy he announced that in the action of potassium cyanide on bromal hydrate dibrom-acetic acid is formed.

The fifth number contains, also, memoirs on the bromoxy-butyric and di-oxy-butyric acid, by MM. W. Petrieff and Eguis; the papers of M. Zinine on derivatives of oxylepiden; of M. Wladowski on the use of SO_2 in the manufacture of grain-spirit; of M. Trapp on a new camphor obtained from the flowers of *Ledum palustre*; and on the absorption of carbonic acid by saline solutions by M. Setschenoff.

Correspondence from St. Petersburg (September 10, 1875).—The sixth number of the *Journal de la Société Chimique Russe* contains account of the session of May 1 (13) 1875.

M. N. Menschoutkine described his researches on the salts of dialuric acid.

M. Potylytzine communicated a paper on the mutual displacement of the haloids. When a molecule of bromine reacts upon a molecule of a chlorinated compound the amount of Cl displaced increases proportionately to the weight of the metal.

M. D. Pavloff announces that in order to prepare the acetons by the action of the zinco-organic compounds upon acid chlorides, it is necessary to take these bodies in the proportion of 2 molecules of the chloride to 1 of the zinco-organic compound.

M. Lebedeff described the condensation of amylen obtained by M. Flawitzky.

M. Beilstein, on behalf of M. Lietny, gave an account of the action of iodine in alcoholic solution upon sulphurea.

M. Lavrinovitsch announced that the reduction of methyl-ethyl-aceton yields well crystallised pinacon.

M. Hemilian announced that he had found notable amounts of ethylic alcohol in the liquid which passes over between 75° and 85° in the distillation of crude wood-spirit.

M. Lioubavine gave an account of glyoxalin, and of a new method of preparing glyoxal.

M. Menschoutkine, on behalf of M. Jazoutkovitch, described the action of oxygen upon coal and paraffin.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 15, December 9, 1875.

This issue contains no chemical matter.

M. Reimann's Farber Zeitung, No 46, 1875.

This issue contains receipts for a blue on half-woollen tissues, a dark green on half-woollen garments; an ordinary and a fast scarlet on woollen yarns; a chamois, a chocolate, and a brown on cotton yarns.

NOTES AND QUERIES.

Loan of Diagrams.—Is there any place in London where I could obtain on loan, for illustrating a lecture, some diagrams on composition and impurities of water, classifications of water, and as described in Parkes's "Hygiene?" Any information on this point will greatly oblige, C. H. L.

Manufacture of Stearin.—Can any of your readers give me reliable information (for scientific purposes) whether in the manufacture of stearin the decomposition with lime under high pressure is still practised, or whether the only process practically in use is that by distillation or by decomposition with water? Also, if possible, for what reasons the old methods have been given up? Also, what is the yield of glycerine by the methods now in use?—GEORGE LUNGE.

TO CORRESPONDENTS.

Dr. Morgan's case.—We have received certain letters and documents relative to this case and testifying in favour of Dr. Morgan's professional skill. Our comments, it will be remembered, were based simply on his extraordinary statement—as reported in the *Chemist and Druggist*—that train-oil was of mineral origin. We are happy to learn that Dr. Morgan formally denies having ever given such an answer. We submit, however, that if Dr. Morgan found himself falsely accused in the public papers, his wisest course would have been to communicate with us at once. In the absence of any facts to work upon we could not declare the report erroneous. We strongly advise Dr. Morgan, above all things, to get rid of that nervousness which appears to have been the cause of the unpleasant scene in court.

THE CHEMICAL NEWS

VOL. XXXII. No. 839.

REMARKS IN CONNECTION WITH THE DISCOVERY OF GALLIUM.

By M. D. MENDELEEFF.

IN 1869 the author announced the following law, called "periodic." "The properties of simple bodies, the constitution of their combinations, as well as the properties of the latter are periodic functions of the atomic weights of the elements."* Among the applications of this law may be cited the following.

This law constitutes the basis of the complete system of the elements:—

of the former according to the periodic law should be the following:—Its atomic weight will be $El=68$; its oxide, El_2O_3 ; its salt will present the formula ElX_3 . Thus its (only?) chloride will be $ElCl_3$, yielding on analysis 39 per cent of metal and 61 of chlorine, and will be more volatile than $ZnCl_2$. Its sulphide, El_2S_3 , or oxysulphide, $El_2(S,O)_3$, will be precipitable by sulphuretted hydrogen, and insoluble in sulphide of ammonium.

The metal will be easily obtained by reduction; its specific gravity will be 5.9, consequently its atomic volume will be 11.5; it will be almost fixed, and fusible at a low temperature. It will not become oxidised in contact with the atmosphere, and at a red-heat it will decompose water. The pure metal melted will be slowly attacked by the acids and alkalis. The oxide, El_2O_3 , will have the specific gravity 5.5, or thereabouts: it should be soluble in strong acids, form an amorphous hydrate insoluble in water but soluble in acids and alkalis. The oxide will form neutral and basic salts $El_2(OH,X)_6$, but not acid salts; its alum, $ElK(SO_4)_2 \cdot 12H_2O$, will be more soluble than the cor-

| Series. | First Group. | Second Group. | Third Group. | Fourth Group. | Fifth Group. | Sixth Group. | Seventh Group. | Eighth Group. |
|----------|--------------------|------------------|--------------------|------------------|--------------------|------------------|------------------|--------------------------------|
| | — R_2O | — RO | — R_2O_3 | RH_4 RO_2 | RH_3 R_2O_5 | RH_2 RO_3 | RH R_2O_7 | (R_2H) (RO_4) |
| 1 2 | $I\ H$ Li 7 | Be 9 | B 11 | C 12 | N 14 | O 16 | F 19 | |
| 3 4 | 23 Na K 39 | 24 Mg Ca 40 | 27 Al ? 44 | 28 Si Ti 48 | 31 P V 51 | 32 S Cr 52 | 35 Cl Mn 55 | Fe 56, Co 59, Ni 59, Cu 63 |
| 5 6 | (63 Cu) Rb 85 | 65 Zn Sr 87 | 68? Yt 88 | 72? Zr 90 | 75 As Nb 94 | 78 Se Mo 96 | 80 Br ? 100 | Ru 104, Rh 104, Pl 106, Ag 108 |
| 7 8 | (108 Ag) Cs 133 | 112 Cd Ba 137 | 113 In ? Di 138 | 118 Sn Ce 140 | 122 Sb — | 125 Fe — | 127 I — | Os 195, Ir 197, Pt 198, Au 199 |
| 9 10 | — — | — — | — Er 178 | — ? La 180 | — Ta 182 | — W 184 | — ? 190 | — — — — |
| 11 12 | (199 Au) — | 200 Hg — | 204 Tl — | 207 Pb Th 231 | 208 Bi — | — U 250 | — — | — — — — |

The periodic law requires the change of the atomic weights of some metals not yet sufficiently studied:—

| | | | | | Atomic Weights of Metals and Formulae of their Oxides. | | |
|----------------------------------|----|----|----|----|---|--|--|
| | | | | | Numbers received. | Numbers proposed. | |
| Indium | .. | .. | .. | .. | 75InO | 113In ₂ O ₃ | The specific heat of indium determined by Bunsen and by the author (<i>Bull. de l'Academ. de St. Petersburg</i> , viii., 45) confirm this change. |
| Uranium | .. | .. | .. | .. | 120U ₂ O ₃ | 240UO ₃ | |
| Cerium | .. | .. | .. | .. | 92CeO Ce ₃ O ₄ | 138Ce ₂ O ₃ Ce O ₂ | MM. Rammelsberg and Roscoe (<i>Ber. Deutsch. Chem. Gesell.</i> , v., 1003, and vii., 1131) accept the proposal. The specific heat of the metal (<i>Bull. de l'Academ. de St. Petersburg</i> , viii., 45) and the composition of its salts (<i>Leibig's Annal.</i> , clxviii., 46) seem confirmatory. |
| Thorium | .. | .. | .. | .. | 116ThO | 232ThO ₂ | |
| Yttrium | .. | .. | .. | .. | 60YO | 90Y ₂ O ₃ | MM. Chydenius and Delafontaine have previously proposed the same change. |
| Erbium | .. | .. | .. | .. | 114ErO | 171Er ₂ O ₃ | |
| Didymium (?) or Lanthanum (?) | .. | .. | .. | .. | 92RO | 138R ₂ O ₃ | |

The periodic law indicates the gaps which still exist in the system of the known elements, and enables us to predict the properties of the unknown elements, as well as those of their compounds. Thus, for instance, there are two gaps in the groups III. and IV. of the fifth series. The author has named these undiscovered elements eka-aluminium, El, and eka-silicium, Es. The properties

responding salt of aluminium, and less crystallisable. The basic properties of El_2O_3 being more decided than those of Al_2O_3 , and less than those of ZnO , it will be precipitable by carbonate of baryta. The volatility as well as the other properties of the saline compounds of El being the mean between those of aluminium and those of indium, it is probable that the metal in question will be discovered by means of spectrum analysis, as was the case with indium and thallium.

These characters of El have been obtained (*Journ. de*

* *Journal de la Soc. Chimique Russe*, t. i., p. 60. Also t. ii., (1870-71) of the author's work (in Russian) "Foundations of Chemistry." See *Liebig's Annalen*, Supplement Band viii., p. 133, 1871.

la Soc. Chimique Russe, 1871, iii., 47) by considering its place in the periodic system of the elements.

| Series. | 2nd Group. | 3rd Group. | 4th Group. | 5th Group. |
|---------|------------|------------|------------|------------|
| 3. .. | Mg | Al | Si | P |
| 5. .. | Zn | El | Es | As |
| 7. .. | Cd | In | Sn | Sb |

It must be further remarked that until the discovery of the periodic law it was impossible to predict the existence of metals still unknown, and to determine their properties.

M. Lecoq de Boisbaudran, having applied his new method of spectrum analysis, announces (*Comptes Rendus*, p. 493) the presence, in the blende of Pierrefitte (Pyrenees) of a new metal, which he names Gallium. The manner in which it has been discovered, the process of its separation (precipitation by H_2S before Zn), and certain properties described (precipitation by $BaCO_3$, solubility of the hydrate in ammonia, degree of volatility, &c.), render it probable that this new metal is eka-aluminium. If further research confirms the identity of the properties just assigned to eka-aluminium with those of gallium it will be an instructive example of the utility of the periodic law.

We may hope that the discovery of eka-silicium, $Es=72(EsO_2)$, whose presumed properties are laid down in *Liebig's Annalen*, Suppl. bd. viii., p. 171) will soon be effected. It should be sought for especially along with arsenic and titanium.—*Comptes Rendus*.

ON CERTAIN PROPERTIES OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

AFTER attempts, which the rarity of the material in question has rendered long and laborious, I have prepared the salts of gallium so pure as to give with the spectroscope, beside a magnificent spectrum of gallium, merely feeble traces of the zinc rays, $Zn\alpha$ 144.62 and $Zn\gamma$ 150.05. Such a proportion of zinc is far below the limit of sensibility of ordinary reagents.

On examining the properties of pure salts of gallium I observed certain deviations from the reactions presented when gallium is mixed with much zinc. This is not surprising, but will require new researches, with which I shall occupy myself when I have recruited my stock of gallium, which has been completely exhausted by the experiments described below. After referring to the properties of a mixture of gallium and zinc, as described in *Comptes Rendus*, September, 1875, p. 495 (and in the *CHEMICAL NEWS*, vol. xxxii., p. 159), the author then proceeds to give the reactions of pure gallium:—

The electric spectrum of chloride of gallium, slightly concentrated, is very brilliant. The ray 417 is much more intense than the ray 404. I have not observed any other ray attributable to gallium; there is certainly none of notable intensity, at least in the physical conditions under which I operated. The colour of the spark in chloride of gallium is a fine light violet. In the gas-flame I only obtained the ray $Ga\alpha$ 417, very feeble and fugitive, even with a salt which gave a brilliant electric spectrum. The chloride and sulphate of Ga are precipitated by ammonia, but the precipitate is in great part soluble in excess. If the portion insoluble in ammonia is re-dissolved in hydrochloric acid, and the operation repeated, all the gallium may easily be obtained in an ammoniacal solution.

An ammoniacal solution of gallium sulphate or chloride, whether cold or hot, is precipitated by acetic acid in excess, except the liquid is extremely dilute. The same salts of gallium, when cold, are not precipitated by acid acetate of ammonia, but the reaction takes place on the application of heat. Gallium sulphate, evaporated and dried almost to the cessation of the escape of white sulphuric vapours, does not lose its solubility in water. Sulphate of gallium is also soluble in water at 60 per cent. I have obtained a

salt which I believe to be ammonia-gallic alum. For want of a sufficient quantity I have been unable to analyse it and measure its angles, but its characters appear sufficiently distinct to warrant my conviction, subject to future verification. The alum in question is soluble in cold water, but on heating the alum is decomposed, and the liquid becomes turbid. This alum is not decomposed when heated with water mixed with acetic acid. It crystallises very readily in cubes and octahedra, presenting exactly the aspect of common alum, and the solution evaporated under the microscope behaves just like known alums. The crystals of gallium alum do not act upon polarised light between two Nicol prisms giving extinction. A small crystal of gallium alum was kept for some time under a layer of water, and then laid in a slightly supersaturated solution of ammonia-alumina alum. It grew immediately therein, and determined the crystallisation of the liquid. With an excess of ammonia gallium alum behaves like the other salts of this metal: a part of the oxide is thrown down, whilst the rest remains in solution. The very acid solution of Ga_2Cl_3 is precipitated by yellow prussiate. The ammoniacal solution of gallium sulphate is decomposed by the voltaic current. Metallic gallium is deposited on the platinum plate which serves as a negative electrode. The positive electrode is covered at the same time with a whitish film, formed by a pellicle which is easily detached from the platinum, and which is insoluble in a large excess of ammonia. In a first operation 1.6 milligrammes of gallium were deposited in four and a half hours on a platinum foil of about 185 square m.m. surface: the surface of the positive electrode was 877 square m.m. The battery was composed of five bichromate pairs (zincs = 17×10 c.m.) connected for tension. The specimen laid before the Academy weighs 3.4 milligrms., and was deposited in five hours forty minutes upon a surface of about 123 to 124 square m.m. The positive electrode was 877 square m.m. The current was furnished by ten bichromate elements, of the same size as above mentioned, and connected for tension. Electrolytic gallium forms a very adhesive layer; it is hard, and polishes very badly when rubbed with an agate burnisher. A better polish is acquired by strong pressure with the agate burnisher. The metal acquires then much lustre, and seems whiter than platinum. When the electric current is duly regulated gallium presents a fine matt surface, of silvery whiteness, finely granulated, and scattered over with small brilliant points, which the microscope shows to be crystals. Gallium deposited on a sheet of platinum does not become notably oxidised on washing with cold or boiling water,* nor when dried in the open air at temperatures bordering upon 200°. It decomposes water acidulated with hydrochloric acid when cold, and more rapidly when hot, with a brisk evolution of hydrogen. The salts of gallium used in my researches have been obtained from the blende of Pierrefitte, of which I have received an abundant supply from M. Malgor, the engineer of the mine. I have also detected the presence of the new metal in other ores of zinc, especially in a transparent blende from Santander, given me by M. Friedel. I believe that gallium will be found in all blendes, and hope soon to possess further information on this point. The gallium which I have extracted from the blendes comes really from these ores, and not from the metallic zinc (Vieille Montagne) used in the precipitations; for I have not obtained traces of gallium with quantities of this zinc greater than the amounts of blende required to show a very distinct spectroscopic reaction of gallium.

My latest researches have confirmed the smallness of the amount of gallium in blende. The extreme sensibility of the spectral reaction caused me to over estimate the quantities obtained. I do not think I exaggerate in saying that in my first observation I possessed at most 1.100 milligram. of this new body, dissolved in a very small drop

* The polished surface, nevertheless, becomes slightly clouded after a few days, owing, doubtless, to a superficial oxidation.

of liquid. The spectral examination of so small a quantity would have been impracticable before the considerable reduction which I have made in the dimensions of the apparatus for obtaining electric spectra, and without my adoption of very small sparks. If, as I suppose, there is no error concerning the nature of my gallium alum, the existence of this salt fixes the atomicity of the new element, and attributes to its oxide the same chemical function as that of alumina. The oxide of gallium will then be Ga_2O_3 .

I have just received the *Comptes Rendus* for Nov. 22, containing M. Mendeleef's very interesting paper on the classification of the elementary bodies, and of gallium in particular. Questions of this kind have occupied me for a long time. I have special ideas on this subject, the substance of which I have deposited with the Institute in sealed packets. However, I have not wished to publish my hypotheses without having submitted them to experimental verification, and without having made some efforts to produce positive results which may confirm them, and permit me to perfect them. I shall return to M. Mendeleef's paper, but for the present I will merely say that the analogy of the spectra of N, Ga, and In struck me since my first observations. I have calculated the equivalent of gallium by applying my first spectral law. In consideration of the solubility of the oxide of gallium in ammonia, and of the impurity of the substance in my possession, I have thought it more prudent to lay before the Academy the facts which I have discovered, reserving for a future occasion an exposition of theoretical considerations. I ought likewise to say that I was ignorant of the description given by M. Mendeleef of the supposed properties of his hypothetical metal. I will even add that this ignorance has probably been favourable to me, for in spite of the incontestable merit of the theoretic ideas of M. Mendeleef, to whose views I am much disposed to give in my adhesion, and supposing the forecasts of this chemist verified altogether, I should have been led to seek for gallium in the precipitates formed by ammonia, and not, as I have done, in the ammoniacal solutions. In fact, the properties of the hypothetical metal ought to "present the mean between those of aluminium and indium," metals whose oxides are almost completely insoluble in ammonia.*

I consider it very probable that without the particular method followed in the present investigation neither the theories of M. Mendeleef nor my own would have for a long time led to the discovery of gallium.—*Comptes Rendus*.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,†

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;

Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 285).

LEAVING these, which are the most important operations whereby sulphuretted hydrogen and organic vapours are evolved, I proceed to a class of manufactures which are nuisances by reason of the irritating acid vapours and gases which they produce; and these may be classified under different heads.

* Oxide of indium is generally considered almost insoluble in ammonia, a property which is utilised in its separation. As for alumina, its solubility in ammonia, though slight, is sensible. It remains to be seen whether the great delicacy of the spectral reaction of gallium, and the minuteness of the quantities upon which I have operated, have not caused me to over-rate the relative solubility of Ga_2O_3 in NH_3 .

† A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

(1.) *Those which generate muriatic acid gas.* Until comparatively recently (since 1863, when the Alkali Act came into operation) the production of carbonate of soda, or rather salt-cake, which is the first step of the process of manufacture, was one of the most offensive and destructive operations in the kingdom. For a distance of miles, indeed, around the *alkali works*, vegetation was blasted, and residential existence was almost impossible. Action upon action at law, therefore, for ruinous damages was the chief entertainment of the parties concerned, and it was a dire struggle between the farm and the factory. The effect of all this was seriously considered by the late Earl of Derby, who brought it under the notice of Parliament and obtained the Act of 1863, which compelled the manufacturer of alkali to condense no less than 95 per cent of all the muriatic acid derivable from the materials which were used; and last year the Act was amended so as to bring other manufactories, as copper works, where salt is the agent employed, as well as vitriol works, &c., under the Act. The amount of muriatic acid escaping from the alkali works is also restricted, not merely to 5 per cent of the quantity made, but to one-fifth of a grain per cubic foot of the gas or air leaving the works. There is hope, therefore, that still further improvements will be effected in these operations.

The method of making salt-cake is first to treat common salt with sulphuric acid in pots (called saturating pots) at the head of a reverberatory furnace, and then to rake out the mixture upon the bed of the furnace, where it is subjected to a red heat for two or three hours. The muriatic acid, which is copiously evolved from the materials, is carried by pipes and flues to a high and capacious condensing tower, where it meets a stream of cold water flowing downwards over the coke with which the tower is packed. The draft of the tower is caused by the furnace shaft, into which the residuum of unabsorbed gas enters. In this way a liquid acid of 28°Tw . (1.140 sp. gr.) is obtained, and this is used with oxide of manganese for making chlorine in the production of chloride of lime (bleach-powder). The red-hot salt-cake, when drawn from the furnace into iron barrows, is highly charged with muriatic acid, which it gives off in copious fumes, so that the workmen are obliged to take some precaution to prevent its effects. The fumes, however, do not extend to any great distance—not many yards from the furnace—and they might be checked altogether by Dr. Roscoe's contrivance of raking the hot furnace charge of salt-cake into a brick chamber underneath the furnace, and provided with an opening into the flue. All these arrangements are, however, under the immediate supervision of inspectors appointed by Government, and they are generally managed with great precautions.

Not so careful, as a rule, are the manufacturers who extract copper from spent pyrites by means of common salt. These pyrites, after having been used by the oil of vitriol maker in generating sulphurous acid, contain from 2 to 4 per cent of sulphur and a small proportion of copper. They are crushed into a coarse powder and mixed with common salt (3 cwts. to a ton of pyrites), and they are roasted in a reverberatory furnace for several hours, whereby muriatic acid gas and a little sulphurous acid escape; and as the manufacturers have not hitherto been under any legislative obligations as regards the proportion of acid evolved, they have generally let it go freely into the chimney shaft. They will, however, be compelled to condense it by means of coke towers, as is done in alkali works.

Common bottle glass is now made from silica and common salt, which are fused together in huge melting pots, and thus immense quantities of muriatic acid gas are discharged into the air.

In like manner the use of common salt as a means of glazing the commoner kinds of pottery (brown ware bottles, jugs, pans, pipes, &c.) is a cause of great offence at Lambeth and elsewhere, from the amount of muriatic acid discharged into the atmosphere.

Brick burning and cement burning are also sources of nuisance from the same cause. In the case of bricks, the salt comes from the cinders (household breeze) used in the burning, which become charged with salt in the dust bins of houses. In the case of cement burning the salt is derived from the mud of the tidal rivers, from which, with chalk, the cement is made. In all these instances, when salt is heated with silica or clay, the alkali combines with the fixed acid and forms a fusible glass or glaze, while the volatile acid (muriatic) escapes. The remedy with the potter and cement manufacturer is to condense the fumes in a proper scrubber; and with the brick-maker the remedy is to use coke breeze, or household breeze that has been well weathered and washed by the rain.

(2.) *Nuisances occasioned by the escape of sulphurous acid.* This is most marked in the manufacture of oil of vitriol, which is always produced from the vapours of burning sulphur. The sulphur employed is either crude native sulphur or pyrites (which contains 35 to 50 per cent sulphur), and the spent oxide from gas-works (which is a mixture of from 40 to 60 per cent sulphur with hydrated oxide of iron and sawdust). The furnaces for burning these several forms of sulphur are very different in their construction, but when properly managed the combustion of the sulphur should be complete, or nearly so, and all the fumes should be carried without escape into the leaden chambers. These chambers are of great capacity, as from 30,000 to 100,000 cubic feet, and they not only receive the fumes of the burning sulphur (sulphurous acid), but they likewise receive nitrous fumes from a pot or small stove containing nitre at the back of the sulphur furnaces, as well as jets of steam which are blown into the chambers from a boiler. The chemical reactions which take place in the chamber are not precisely understood, but the practical effect of them is that the sulphurous acid, or anhydride (SO_2) with nitrous fumes (N_2O_3) and steam or water (H_2O) form sulphuric acid (H_2SO_4) and nitric oxide (N_2O). The former is precipitated to the bottom of the chamber, where it is dissolved in the water present, and the latter (nitric oxide) escapes to take oxygen from the air of the chamber, and so again forms nitrous fumes for a similar reaction. The nitrous fumes, therefore, are merely the purveyors of oxygen from the air to the sulphurous acid, and would, in the presence of oxygen alone, act indefinitely; but as the oxygen of the air in the chamber is associated with nearly four times its volume of nitrogen, it follows that as the former is abstracted the latter accumulates, and must be replaced by fresh atmospheric air. Hence the necessity for a current of air through the chambers, and this current of air carries with it notable proportions of sulphurous acid and nitric oxide, which, escaping into the atmosphere by the chimney shaft, are the cause of injury to vegetation and annoyance to the neighbourhood. The extent of this escape of noxious gases may be determined in several ways:—First, the relation between the quantity of materials used and the amount of oil of vitriol produced. Theoretically, 100 parts of sulphur should produce 306.25 parts of monohydrated sulphuric acid (H_2SO_4); but in practice it varies from 200 to 294 parts. The nitre also employed at the works ought not to exceed 2 parts by weight for every 100 parts of sulphur, but in reality it is rarely less than 4 parts, and it ranges from this to 12 parts or more. In those cases where spent oxide is used as a source of sulphurous acid, the quantity of nitre is rarely less than 7 per cent. Secondly, the amount of escape may be ascertained by examining the gases which pass from the chambers to the chimney shaft. There is always a means of doing this with considerable accuracy by abstracting the gases from the flues which connect the chambers with the general shaft. According to Dr. Roscoe, a cubic foot of these gases ought not to contain more than 1 grain of sulphur in any form; whereas, in badly managed works, the quantity may reach to 16 grains per cubic foot. The air of the chimney shaft, also, should not contain more than a quarter of a

grain of sulphur per cubic foot, and of this a little more than half is derived from the coke or coal burnt in the furnaces. The remedies for this waste are twofold:—First, the exercise of care in the conduct of the works—regulating the sulphur furnaces so that no fumes escape therefrom, and a proper supply of air is admitted into the chambers. In well managed works it is customary to have glass pressure syphons communicating with the exterior of the various chambers, so as to watch and regulate the condition of them. The chambers, also, should be completely surrounded and enclosed with casing, having a gallery or passage-way round, so that any and every escape may be at once detected. Second, the effluent gases should be passed through scrubbers charged with absorbent liquids. Oil of vitriol, for example, flowing through the scrubber in a small graduated stream, will absorb the oxides of nitrogen, as suggested by Gay-Lussac; and water will take up any trace of sulphurous acid. Both of these liquids can be made to flow into the leaden chamber, and be thus utilised. At several oil of vitriol works which I have inspected it is the practice to carry the gases, which may by accident escape from these absorbent agents, through a lime purifier, before they go to the tall chimney shaft; and in this way all chance of annoyance is prevented.

The sulphuric acid which collects at the bottom of the leaden chamber is continually drawn off at a sp. gr. of 1.600. This is called "chamber acid," and as it is too weak for general purposes, it has to be concentrated by evaporation. This is done to a certain extent in leaden pans, where it reaches a gravity of about 1.720, making the "brown acid" of commerce; and the further concentration is effected in vessels of platinum or glass, where the acid obtains a gravity of from 1.845 to 1.854, which is the "oil of vitriol" of English commerce. All of these operations are offensive, from the escape of acid, unless they are well conducted.

It is necessary, therefore, in the management of oil of vitriol works, to take care—

First, that the sulphur furnaces are burning properly, and are not permitting any escape of sulphurous acid.

Second, that the leaden chambers and flues therefrom are constantly sound and air-tight.

Third, that the gases in the flues from the leaden chamber do not contain above 1 grain of sulphur per cubic foot.

Fourth, that these gases are passed through a water scrubber and an oil of vitriol scrubber in succession, before they go to the chimney shaft; and

Fifth, that the evaporation and concentration of the chamber acid, as well as the brown acid, be conducted without the escape of offensive gases.

Another source of annoyance from the escape of sulphurous acid, is where the *noble metals* are refined by boiling the alloys in oil of vitriol. This, however, is easily guarded against by conducting the operations in closed vessels and carrying the evolved gases through an alkaline solution, whereby valuable sulphites and hyposulphites may be obtained for commerce.

Lastly, there is often a considerable escape of this gas from the chambers where *bleaching operations* are carried on by means of burning sulphur, as, for example, in the bleaching of woollen goods, straw bonnets, hair, hops, nuts, spice, &c.; and in these cases the refuse gas should be carried through some absorbent liquid or solid (lime for example) by means of a fan or draught to a chimney.

(3.) *There are certain manufacturing operations which are attended with the escape of nitrous fumes* and are exceedingly irritating and offensive. As I have stated, these fumes may escape from badly managed *vitriol works*. They are also caused when *oxalic acid* is produced from saccharine matters by the action of nitric acid. *Refiners* also discharge large quantities of the acid into the air when they treat the alloys of the noble metals with nitric acid. The *makers of tin and iron liquors*, of *nitro-benzol*, and of *picric acid*, are likewise producers of these irritating

fumes when they act upon the several materials with strong nitric acid. The remedy for the nuisance is the carrying on of such operations in closed vessels, and the conveyance of the nitrous fumes through water or an alkaline liquid (milk of lime) by which the red fumes are entirely absorbed or arrested.

In the manufacture of *bleach-powder* (chloride of lime) there is occasionally an escape of chlorine, but it is nearly always accidental unless the works are managed with great carelessness. The chlorine is generally made from the liquid muriatic acid, which flows from the condensing towers at the alkali works. The acid has a gravity of from 25° to 28° Tw. (1.125 to 1.140) and it is run into a still upon peroxide of manganese, and stirred and heated so as to promote chemical action. The chlorine which is thus evolved is passed into chambers containing layers of finely slaked lime, slightly damp, to the depth of from 3 to 6 inches. The residual liquor in the still, which is a solution of chloride of manganese and free acid, of the strength of from 26° to 30° Tw., is, in many cases, not allowed to run to waste and be a cause of annoyance, but is treated with lime and air to recover the oxide of manganese. The first step of the process is to neutralise the free acid of the liquor by means of chalk (carbonate of lime), which does not decompose or act upon the chloride of manganese. When the effervescence is over and the liquor has become clear by subsidence, the supernatant solution of chloride of manganese and chloride of calcium is drawn off into another vessel called an "oxidator," where it is subjected to the action of a proper proportion of cream or milk of lime, which decomposes the chloride of manganese and forms a precipitate of oxide of manganese. Air is now blown into the mixture until the protoxide of manganese is converted into peroxide, and when this is complete it is allowed to settle, and the solution of chloride of calcium is either utilised or is run away to waste. Chlorine is also made from gaseous muriatic acid by the oxidising action of the air at a high temperature. In this case the muriatic acid gas from the salt-cake furnaces is carried with atmospheric air into chambers heated to a low red heat (about 1000° F.), and here and in another chamber called an "oxidator," the hydrogen of the muriatic acid is oxidised and the chlorine set free. The mixed gases and vapours of chlorine, muriatic acid, and steam, are passed through condensers to cool them, and the moist chlorine is finally dried in a sulphuric acid scrubber, and then conveyed to the lime chambers. This method of generating chlorine requires care and attention, as the high temperature of the decomposing apparatus is very likely to lead to fissures and cracks in the apparatus, which will permit an escape of irritating gases.

(To be continued.)

RAPID MODE OF DETECTING THE ADULTERATION OF BUTTER WITH OTHER FATS.

By J. W. GATEHOUSE,

Lecturer on Chemistry at the Somersetshire and Bath Proprietary Colleges.

THE following method is based on the insolubility of potassium stearate in alkaline solutions, when the stearate has been produced at high temperatures.

Before the application of the test, it is essential that all curd, butter-milk, and salt be removed, and for this purpose the butter should be thoroughly washed in boiling water, and, if necessary, dissolved in ether.

Take about 20 grains of the butter, place it in a large test-tube—dimensions about $6 \times \frac{3}{4}$ inch—and fill the tube one-third full with water, boil thoroughly, and allow to stand till the fat has accumulated at the top.

Two modes now present themselves—first, either to dissolve the fat in ether, and saponify after evaporation; or, secondly, and I think more conveniently, extract the lower layer of liquid by means of a pipette, which may be readily effected with a minimum of loss in the following way:—

Draw out a piece of thin glass tubing, sufficiently long to reach to the bottom of the tube, to a fairly fine point, but not too fine, and bend the top to an obtuse angle. Whilst the butter is still liquid, insert this nozzle to the bottom of the test-tube by placing the finger over the upper end, so that no liquid may get in till it reaches the bottom of the tube. Allow it, now, to remain till the butter is cold and fairly set, when, by means of an inch of small caoutchouc tubing, attach to a sufficiently large pipette, and withdraw the whole of the liquid, the butter will, if sufficiently cooled, remain in the middle of the tube.

This process can be repeated till the washings show the absence of chlorides when tested with nitrate of silver.

The saponification is effected by heating the purified butter with from one-third to one-half its own weight of solid potassium hydrate perfectly free from salts of sodium (the best being the hydrate purified by alcohol) to a temperature above 420° F.

Eight grains of potassium hydrate easily saponifies the 20 grains of butter.

The heat should be applied gently at first, and when the frothing is becoming less, a higher temperature may be applied till no further apparent action occurs, and a porous mass remains at the bottom of the tube.

Should the butter be pure, the colour of this mass will be, at the utmost, light yellow interspersed with a few light brown patches; but should the butter be adulterated to any extent, it may be almost black. Too much reliance, however, must not be placed on the colour.

It is essential that the ultimate temperature during saponification be kept at above 400° for some minutes, else the potassium stearate formed will be soluble instead of insoluble in the alkaline solution. For this purpose in the first experiments it is advisable to use a bath of molten tin or lead, but having once noticed the series of reactions which occur, the flame of the Bunsen burner can be used quite as conveniently and more advantageously.

Having allowed the tube and its contents to cool, boil the saponified mass with successive portions of distilled water till 6oz. or (200 cubic centimetres) altogether have been used. The absolute amount of water used is not material, but having once determined on the amount, it must be rigidly adhered to.

A portion of this solution poured into a test-tube half an inch in diameter will present only a faint opalescence if the butter is pure, but a decided opacity if impure, the degree of opacity depending on the amount of adulteration.

In order to determine the amount of adulteration in any sample, a pure butter should be first obtained from cream, which is easily effected by churning cream for from 15 to 30 minutes in a wide-mouth bottle, and adding to separate portions of its known percentages of lard, &c.

Saponify each of these as stated above, and cork them up in tubes of equal diameter, labelling each with the percentage of lard it contains.

On comparing them, it will be seen that 2 per cent of lard can be clearly indicated.

When a butter is analysed, all that remains to be done is to saponify, make up the solution to the correct amount, and after cooling, pour out a portion into the tube, when comparison is easily made with the specimen tubes.

It is possible to weigh the amount of potassium stearate thus produced; but as the process of washing is tedious and the weighings never absolutely accurate, the comparison method is to be preferred.

Royal School of Mines.—The third Annual Dinner of the Students of the Royal School of Mines was held on Friday, the 17th instant, at the St. James's Hall Restaurant. In spite of the unavoidable absence of many who had expressed their intention of being present, the Students, Associates, and Professors mustered to the number of nearly sixty.

PROCEEDINGS OF SOCIETIES.

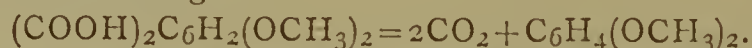
CHEMICAL SOCIETY.

Thursday, December 16th, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. J. F. M. Harris Stone, R. L. Barnes, and F. C. Desvignes were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. J. Watson, W. Galbraith, D. E. Brown, A. H. Scott White, M.A., G. Wilson M.A., W. Foulkes Lowe, S. W. Nockolds, G. Haycraft, F. J. Lloyd, H. Allen, F. Isenbart Scard, H. Bailey Dixon, and W. A. Smith. For the third time—Messrs. William Harkness, William Auld Stewart, Alfred Smetham, John Davies Mucklow, H. G. Ivey, Bernard Shirley Dyer, A. E. Evans, George Cheverton, Arthur Talbot, and George Herbert Bailey, who were ballotted for and duly elected.

The first paper, "*Narcotine, Cotarnine, and Hydrocotarnine*," by Mr. G. H. BECKETT and Dr. C. R. A. WRIGHT, was read by the latter. The authors, on repeating the experiments of Matthiessen and Foster, of fusing opianic acid with caustic potash, found that, as they had stated, it was converted into meconin and hemipinic acid, but that the latter contained a small quantity of another acid, which gave a blue tint with ferric chloride, and which was méthylnormeconin, $C_9H_8O_4$. On heating dry sodium hemipinate with dry soda-lime a heavy oil was obtained, which on examination proved to be dimethyl-pyrocatechin, the reaction being—



When treated with strong hydriodic acid the dimethyl-pyrocatechin is converted into pure pyrocatechin, with simultaneous formation of methyl iodide. If hemipinic acid is fused with caustic potash, the following reaction takes place—



potassium protocatchuate being produced: these results conclusively proving that hemipinic acid is a carboxyl-dimethyl-protocatchuic acid $(COOH)_2C_6H_2(OCH_3)_2$. It seemed probable from the results obtained with hemipinic acid that on heating sodium opianate with soda-lime, methyl-vanillin, $(COH)C_6H_3(OCH_3)_2$, would be produced, and on making the experiment such was found to be the case, although the yield was comparatively small. By the action of oxidising agents methyl-vanillin is converted into dimethyl-protocatchuic acid, $COOH.C_6H_3(OCH_3)_2$, and when treated with hydrochloric acid it yields vanillin, $COH.C_6H_3(OCH_3)(OH)$, and methyl-chloride. The action of hydriodic acid on hemipinic acid has also been studied by the authors, who find that methyl-norhemipinic acid, $(COOH)_2C_6H_2(OCH_3)(OH)$, is first produced, and that by a continuance of the action this is then converted into methyl-protocatchuic acid and finally into protocatchuic acid: somewhat analogous results are obtained with hydrochloric acid. The decomposition which methyl-norhemipinic acid undergoes when fused with potassic hydrate results, as might be expected, in the formation of protocatchuic acid, and when heated alone it yields methyl-protocatchuic acid. The concluding portion of the paper describes the action of fused potash on meconin, the product of the reaction being methyl-normeconin, $C_9H_8O_4$; and when this is fused with a large excess of potash, protocatchuic acid is obtained, the methyl-normeconin being probably first oxidised to methyl-norhemipinic acid, which is subsequently converted into protocatchuic acid. Dr. Wright said he might also state that he had succeeded in obtaining a new opium alkaloid, *oxynarcotine*, the formula of which was—



resembling that of narcotine, except that it contained the group $COOH$ instead of COH .

Dr. ARMSTRONG said he could only express his conviction that the evidence adduced for the formula of hemipinic acid and opianic acid was most complete and conclusive, but he could not say as much for that of meconin, resting as it did chiefly on the action of caustic potash on the substance. The evidence for the formula of narcotin, also, was not quite conclusive, one point being that although when heated with water, meconin, and hydrocotarnine, are the only products,—



Dr. Wright had assumed that opianic acid was first formed and then reduced to meconin, but he had never proved that opianic acid could be reduced to meconin.

Dr. WRIGHT replied that if he attempted the reduction of opianic acid with the ordinary reagents, such as zinc and sulphuric acid it was highly improbable that that agent would reduce the carboxyl group, $COOH$, in opianic acid $(OCH_3)_2(COH)C_6H_2.COOH$.

Dr. ARMSTRONG conceived that the formula adopted by Dr. Wright was the most probable, the results he had himself obtained corroborating this view, but he must say the experimental evidence was not conclusive.

Dr. H. E. ARMSTRONG then read two communications by himself and Mr. G. HARROW, the first of which was "*On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol*." When trichloro-phenol is heated at $170^\circ C.$ with a concentrated aqueous solution of potassic sulphite, a mixture of potassic dichloro-phenol-sulphonate and chloro-phenol-disulphonate is obtained, which, when acted on by nitric acid, yields dichloro-ortho-nitro-phenol and para-chloro-diortho-nitro-phenol, proving that in trichloro-phenol, which has the constitution—



the two atoms of chlorine in the *ortho* position are displaced. When, however, the experiment is reversed, and the sulpho groups in ortho-chloro-phenol-ortho-para-sulphonic acid is displaced by chlorine, the two possible dichloro-phenol-sulphonic acids are formed, namely, dichloro-phenol-ortho- and dichloro-phenol-para-sulphonic acids. Mono- and dichloro-phenol are also readily acted on by potassic sulphite, and can also be converted into sulpho-salts by its action. Tribromo-phenol behaves very differently. When heated to 170° with potassic sulphite very little sulpho-salt is produced, it being chiefly converted into an amorphous body insoluble in alkalis and in alcohol, and which has not, as yet, been obtained in a state fit for analysis. As potassium sulphate is formed in the reaction it is evident that the tribromo-phenol must have undergone reduction, and may perhaps have become converted into a bromo-derivative of the so-called phenylene oxide, $C_{12}H_8O_2$.

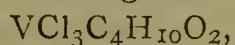
The second communication was a "*Note on the Action of Nitric Acid on Tribromo-phenol*." It is well known that nitric acid converts trichloro-phenol into dichloro-quinone, but the authors find that tribromo-phenol yields para-nitro-dibromo-phenol when acted upon with nitric acid. If more than 1 molecule of nitric acid be employed the nitro-dibromo-phenol is further converted into dinitro-bromo-phenol, and the latter alone is obtained if the phenol be added to an excess of the acid.

The PRESIDENT having thanked the authors in the name of the Society,

Mr. E. NEISON read a paper on "*The Sebates of the Alcohol Series*," in which, after referring to his published examination of the metallic sebates, he described the methods he had adopted in the preparation of the alcoholic sebates, and the properties of the resulting compounds. The methyl sebate was obtained by the action of sulphuric acid on a solution of sebacic acid in methylic alcohol. It crystallises in pearly needles and plates, which melt at $38^\circ C.$, and boil at $287^\circ C.$, but the substance is at the same time decomposed. The ethyl sebate, which closely resembles the methyl sebate, was prepared by passing

hydrochloric acid into an alcoholic solution of the acid. It melts at 3.5°C ., and boils at 307°C . Ethyl-hydrogen sebate is also formed in the preparation of ethyl sebate, but in comparatively small quantity. Amyl sebate, prepared in a manner similar to the ethyl salt, is an oily liquid boiling at about 366°C ., and of specific gravity 951 at 18°C . The author has also prepared and examined hydrogen-amyl sebate.

The SECRETARY then read a communication from Mr. P. P. BEDSON "*On some Compounds of Ether with Anhydrous Metallic Chlorides*." When ether is heated with vanadium oxychloride for two or three hours at 70°C . a compound is produced having the composition—



which may be obtained in long needle-shaped crystals, melting at 20°C . They are, however, very unstable, readily undergoing spontaneous decomposition. Ether acts violently on titanium tetrachloride, producing the compound $\text{TiCl}_4\text{C}_4\text{H}_{10}\text{O}_2$. It forms a yellow crystalline mass, which melts at about 45°C ., and boils at about 120°C . At the same time a compound, $\text{TiCl}_3(\text{OC}_2\text{H}_5)$, which the author calls titanichlorhydrin, is formed, especially if the mixture be quickly heated in an oil-bath. It melts at about 78° , and boils at about 188° .

The last paper was entitled "*Observations on Variations in the Composition of River Waters*," by Mr. J. ANDREWS, and contains an account of the total solid matter and the loss by ignition of the waters of the Don, a Yorkshire stream, collected at different periods, both during dry seasons and at flood times.

The PRESIDENT, after thanking the author, announced that the meeting would be adjourned until January 20, when a paper "*On Narcotine, Cotarnine, and Hydrocotarnine (Part IV.)*," by Mr. G. H. Beckett and Dr. C. R. A. Wright, would be read.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

JOHN PATTINSON, President, in the Chair.

PRESIDENT'S ADDRESS.

(Concluded from p. 290.)

THE Weldon process of bleaching-powder making still continues to make great progress. Mr. Weldon tells me that, leaving out of account the 10,000 tons or so of bleaching-powder made by the Dunlop process in Glasgow, considerably over 90 per cent of the total bleaching-powder made in Great Britain is now made by his process. It is also being extensively adopted in the continental works. I frequently hear reports from persons using this process of the ease and regularity with which it is conducted. On the Tyne, Mr. Weldon says, a ton of bleaching-powder for about 55 cwts. of salt decomposed is obtained in more than one manufactory, whilst in Lancashire still better results have been found; for in one works the acid from little more than 50 cwts. suffices to yield a ton of bleaching-powder. No doubt the difference in yield found in different works depends in a great measure on the methods of condensation of acid adopted. I have Mr. Weldon's promise that he will endeavour to prepare a paper for this society this session on the methods of condensation followed respectively on the Tyne and in Lancashire, and also in France and Germany.

The manufacture of bleaching-powder by the Deacon process has diminished on the Tyne, only two works following it at present. The conditions of continuous successful working have evidently not yet been discovered.

In the chemistry of the processes employed in that other important industry of our district, the treatment

and manufacture of lead and its compounds, there is no much that is very new to record. Some attempts have been made to introduce a wet method of producing white-lead as a substitute for that produced by the old Dutch process, but hitherto, I believe, with but little success. Other processes with this end in view are in progress, of which we may hear something in the future. The principle of separating silver from lead discovered by that gifted and good man, the late Hugh Lee Pattinson, still remains the one on which the greater part of the lead is treated in this district—I mean that based on the fact that the crystals of lead which first form from a cooling mass of molten argentiferous lead contain much less silver than that portion which remains in a molten condition. The mode of applying this principle in practice, although still largely used in the manner suggested and carried out by Mr. Pattinson, has undergone many modifications and improvements. One of the most notable of these is now being adopted on a large scale by Messrs. Cookson and Co., at their works at Howdon, and is being used by Messrs. Walkers, Parker, and Walker, at their Elswick works, and by the London Lead Company at their works at Stanhope. The process is the invention of M. Rozan, and consists in passing a jet of high-pressure steam through the molten lead, and running on the surface a stream of cold water in order to promote the rapid formation of crystals. The pan in which this operation is performed is placed at such an elevation that the fluid portion of the lead can be run from the bottom when the required amount of crystals has been formed. The application of steam has also the important advantage that it oxidises the copper, antimony, and other impurities in the lead, so that the usual preliminary process of "improving" in a separate calcining furnace can be dispensed with in the treatment of pig lead containing an ordinary amount of these impurities. The amount of dross formed in the new steam process is only five-eighths of that made by the old process. Messrs. Cookson and Co. have supplied me with data from which I find that the cost of labour in producing a ton of market lead from hard silver-lead containing from 80 to 100 ozs. of silver per ton, is, by the old process, 17s.; by the new steam process, 3s. The amount of fuel, including that required for calcining, is 18 cwts. per ton in the old process; and 6 cwts. per ton, including that required for generating steam and working cranes, in the new process. On the other hand, the wear and tear of plant is much greater in the steam process; but this I understand is amply compensated for by the saving in working expenses. In Messrs. Cookson and Co.'s manufactory, where I have had the pleasure of seeing this process at work, there are the most admirable engineering arrangements for the saving of labour. The lead from its entrance into the works to its exit as market lead is only twice lifted by human hands.

Within the last few years Messrs. Lock, Blackett, and Co. have worked a modification of Parkes's process of desilverisation by means of zinc, which is said to be more economical than the Pattinson process. In this plan the lead is melted, without previous improving, in large iron pots, and about $1\frac{1}{2}$ per cent of its weight of zinc is added in three successive portions. After the addition of each portion, the mixture is well stirred for about half an hour. The fire is then damped down, and the contents of the pot allowed to cool. The zinc combined with most of the silver floats to the top, and when sufficiently solidified the crust of zinc and silver is removed. This is repeated after each addition of zinc. The desilverised lead is now run into an improving furnace, where it is heated until the small quantity of zinc remaining in the lead is oxidised and separated. The lead then is soft and ready for the market. The crusts of zinc and silver are heated in pots so as to separate some of the lead still remaining. The zinc and silver alloy is then heated in plumbago crucibles in order to distil off the zinc, and the residue of silver and lead is cupelled in the ordinary way to separate silver.

The manufacture of acetic acid on a new plan has lately been commenced by the Tyne Acetic Acid Company at their works at Scotswood. The property of a solution of chloride of calcium and acetate of lime of forming crystals of the double salt is taken advantage of in order to get rid of tarry and other organic matters. The process is patented by Mr. Condry. A very fine quality of acetic acid is produced suitable for use in the manufacture of pickles, and for other purposes where a pure acetic acid is required.

The steam jet apparatus of Messrs. Körting Brothers is already extensively applied to various purposes in chemical works and other manufactories in England, as well as in America and on the Continent. This apparatus consists of a jet of high pressure steam applied somewhat like a Gifford's injector through a series of conical tubes for the purpose of moving or forcing gases and liquids in any required direction. It has been applied to force air through the gas-producers in connection with Siemens's furnaces and to the fires of ordinary steam boilers. For ventilating purposes it has been applied to workshops, mines, drying rooms, and other places. It has been somewhat extensively applied as an exhauster in gas-works to take off the pressure of gas in the retorts, and also for revivifying the oxide of iron used in purifying gas without removing it from the purifiers. Steps are now being taken to apply it to the carbonating and other furnaces of chemical works in this district. When applied to ordinary steam-boilers the apparatus is arranged so as to force air through the fire from below the grate. Several of these have already been fitted up in this neighbourhood, and, it is said, have been the means of effecting a considerable reduction in the amount of fuel used. Mr. Marshall, of the firm of Messrs. R. and W. Hawthorn, has furnished me with the following particulars, showing the amount of fuel used before and after the application of the Körting blowers in their engineering works at St. Peter's, near Newcastle. Before the Körting apparatus was applied, a Root's boiler and a Cornish boiler, consuming together in 230 hours of twenty consecutive days 78 tons 2 cwts. 2 qrs. of unscreened coal, were used to raise steam for the requirements of the works. With the Körting apparatus they find they can dispense with the Cornish boiler, and the same work was done in the same number of hours with 36 tons 7 cwts. 2 qrs. of a mixture of two-thirds of small coal and one-third unscreened. There is in this case a saving of upwards of 50 per cent of fuel. At a Cornish boiler in their works at Newcastle the economy is not so marked, but it is still considerable. For doing the same amount of work for twenty consecutive days of 12 hours each, there were required per day:—With natural draught, 96 cwts. of unscreened coal at 12s. 6d. per ton; with the Körting blower, 90 cwts. 2 qrs. 10 lbs. of small coal at 7s. per ton; thus showing a saving of about 28s. per day. The reasons why this economy of fuel can be effected with this apparatus appear to be the following:—1st. The intensity of combustion is very great, owing to the air being brought under pressure into contact with the fuel. The proportion of heat utilised under these circumstances is greater than it is with a slower combustion. 2nd. The combustion is quite independent of chimney draught, so that the heat required for producing chimney draught can be used for raising steam. 3rd. The fuel, even if of an inferior description, is burnt completely away, so that none is thrown away with the ashes. I deem this invention worthy of the attention of all our members engaged in manufacturing operations.

Spectrum analysis has been one of the most important discoveries of our time and one most fruitful in its results. By its means not only have we been able to learn the constituents of the sun and the most distant stellar bodies, but the existence of several new elements has been revealed to us through its agency. So lately as two months ago the announcement comes of the discovery of another element by its means, which its discoverer, M. de Bois-

baudran, proposes to call "Gallium." It was found in an ore of zinc, and appears to have chemical characters similar to the latter metal. Sundry attempts have been made by Mr. Norman Lockyer and Mr. Chandler Roberts to make spectrum analysis available for obtaining quantitative results, and a certain measure of success has been arrived at by these gentlemen in examining alloys of the precious metals, but scarcely sufficient to warrant them in recommending its adoption in the place of other known methods of analysis. Sir John Alleyne, of the Butterley Iron Works, has more recently announced a method of applying spectrum analysis to the determination of small quantities of phosphorus in iron and steel. Sir John read a paper on the subject before the Iron and Steel Institute, and showed the apparatus in action at the meeting of this body in May last. He discovered that the lines of the spectrum indicating phosphorus are blotted out or rendered invisible in an atmosphere of hydrogen gas, and the amount of oxygen gas (which he introduces in the form of carbonic acid) required to make these lines visible, forms a measure of the amount of phosphorus in the iron or steel under examination. The process, so far as I am aware, has not yet been carried into practical use in any steel works, but it suggests a most promising field for future research.

Although, as I have said at the commencement of this address, the work of the last session has been equal in amount to most of its predecessors, it must not be thought that there is no scope for improvement in this respect in the future. It cannot be urged that there is any dearth of subjects suitable to be dealt with. Almost any one of the processes I have alluded to this evening would form an excellent subject for a paper. Let me, in conclusion, then ask that a larger number of our members will undertake the preparation of papers in the session now commencing in order that the time spent at our meetings may be fully and usefully occupied, and the prosperity of our society not only maintained but increased.

Mr. GLOVER, in moving a vote of thanks to the president, endorsed all that had been said with regard to the "soda-test." As to the modified balling process, he doubted the advantage of introducing caustic lime. Speaking of the spontaneous combustion of coal, he said, in his evidence before the Commission, he had pointed out that the mere presence of pyrites in coal was of less consequence than the state of division in which it existed. As to the pollution of rivers, they ought to be careful how they interpreted the term. He was of opinion that some rivers might be manured with as much advantage as fields. The sewage fed infusoria, and infusoria fed fish which fed us. Within certain limits, then, the addition of organic matters to a river might be actually useful.

Mr. BERKELEY seconded the vote of thanks, which was carried by acclamation.

The PRESIDENT, in returning thanks, said the members would best thank him by themselves contributing papers on the subjects which came within the scope of their daily work.

NOTICES OF BOOKS.

Dyeing and Calico-Printing, including an Account of the Most Recent Improvements in the Manufacture and Use of Aniline Colours. By the late Dr. F. CRACE-CALVERT, F.R.S., &c. Edited by J. STENHOUSE, LL.D., F.R.S., &c., and C. E. GROVES, F.C.S. Manchester: Palmer and Howe. London: Simpkin and Marshall.

IN no department of industrial science is there so much room for new works as in connection with the arts of dyeing and calico-printing. So wide is the subject, so rapid are its advances, and so difficult—or rather impos-

everything of value which it presents, that a competent and conscientious author is sure to lay before his readers much which is both novel and useful. It is therefore with sincere pleasure that we welcome this posthumous production of the late lamented Dr. Calvert—a man who has passed away from our midst too soon for science. As the latest fruit of his mind, it derives for all who had the pleasure of his acquaintance an additional interest.

The work before us does not profess to enter into all the technical details of the tinctorial arts. Into the plant and machinery of the dye-house, the printing-shop, and the colour-factory it enters but slightly. Nor does the preparation of the various compounds of alumina, iron, tin, and chrome used as mordants, or the preparation and application of the mineral colours, come within the author's plan. After treating of colours in general—their cause, nature, behaviour with light, heat, electricity, bleaching-agents, &c.—he reviews madder, with its various natural constituents, commercial preparations and uses, and its modern substitutes—artificial alizarin and anthrapurpurin. He next passes to the red dye-woods, safflower and alkanet; indigo, with the new process of Schützenberger and de Lalande; cochineal, lac and murexide; orchil and its connections, including the new and charming colour eosin; quercitron, fustic, Persian berries, and other natural yellow and orange dyes; tannin, its sources and products, among which figure gallein and cœrulein. Next follows a section on the examination of colouring-matters and coloured fabrics. The remaining chapters are devoted to the manufacture and uses of the aniline, phenol, cresol, and naphthalene colours, and give—if not all practical details—a correct and comprehensive view of the latest improvements in this region of tinctorial chemistry. An appendix gives a series of very useful tables for distinguishing the different colouring matters as fixed on tissues by dyeing or printing.

Among the numerous patterns of dyed and printed tissues, with which the work is illustrated, a particular interest attaches to those of eosin, gallein, cœrulein, French purple, and garancin with an uranium mordant—the latter a novel and pleasing effect.

The work, it must be distinctly understood, is not mainly, or professedly, a collection of receipts and formulæ—though these are by no means wanting. But the thoughtful dyer or printer will find it full of suggestions, which in good hands will prove much more valuable than mere receipts. As a specimen of these hints we extract the following passage:—"If dyers, instead of using catechu as imported, were to grind it and wash with cold water, they would obtain an extract which would yield very pure shades of green-drabs, whilst the insoluble residue of catechin would give a great variety of tints." Is it too much to say that in these few lines the germs of many practical receipts are lying dormant?

We do not, of course, maintain that the work is in all respects faultless. There are passages which may possibly be considered needless digressions, such as the account of kermes, and the notice of the occurrence of indigo in human urine. Possibly the space thus filled might have been more usefully occupied. The process given for the preparation of archil is not by any means the most improved in existence. But, in spite of these and certain other occasional blemishes, every candid reader, capable of judging, must pronounce this book a most valuable addition to our technological literature. No dyer, calico-printer, colour manufacturer, or student of tinctorial chemistry can consider his library complete without it.

The author's literary executors, Dr. Stenhouse and Mr. Groves, have been well selected, and have faithfully performed their task. We must, in conclusion, express our confident hope that this work will subserve that end for which its author laboured with such skill and perseverance—the promotion of a more truly scientific spirit among our dyers, and printers, and colour-makers, and, in consequence, of a new impulse to English tinctorial art.

CORRESPONDENCE.

"PREVENTION BETTER THAN CURE." FOOT-AND-MOUTH AND OTHER CONTAGIOUS DISEASES AMONGST ANIMALS.

THE following letter, addressed to His Grace the Duke of Richmond, Lord President of the Privy Council, has been forwarded to us for publication:—

TO HIS GRACE THE DUKE OF RICHMOND.

MY LORD DUKE,—In common with the public generally I have read with much interest and satisfaction your remarks on the prevailing cattle-diseases and the measures adopted for their repression. The present system of eradicating such disease, by the destruction of the animal affected, I cannot help thinking is not in harmony with the dictates of Science or sound reasoning. If it is true that "Prevention is better than Cure," and that "Cleanliness is Godliness," then it would seem the principle of "stamping out" is an inconvenient, wasteful, and extravagant process, and that our efforts should be more directed to disinfection and promoting comfort and cleanliness amongst cattle in transit, whether by rail or by sea.

The promotion of comfort and cleanliness amongst animals is a matter that requires no definition, but the question of disinfection is a matter that must be subject to the laws and experience of Science. The public mind is at this moment somewhat puzzled by confounding the terms "disinfectants" and "deodorants" with each other, whereas I believe their functions are quite distinct; the object of the one is to destroy those invisible organic germs which constitute contagious matter, whilst the other is simply by chemical action to decompose or alter the character of a gas, and at the same time change its natural odour or smell: the latter action is explainable by the merest tyro in chemistry, whilst the action of disinfectants is past explanation; all that can be said is that experience teaches that they do destroy or kill the contagious organism. If, then, this definition of disinfectants and deodorants is acceptable as true, it follows that in the matter of contagious disease—whether of man or animals—the two things must not be confounded, and that, however agreeable it may be to be rid of unpleasant smells by the action of oxidising or deodorising agents, we are in no degree by their employment defending ourselves against the deadly attack of the germs of contagion: one is the business of a perfumer,—or, more properly, anti-perfumer,—whilst the other is a "battle of life:" it is a test of what Darwin would call the power of the fittest to survive. Who shall say that epidemics and contagion, after all, are only vital storms to blow away feebleness, that health and vigour may have a better and larger field for existence and development. The natural tendency of feebleness without protection is to succumb to disease, and create consequent contagion, whilst the more powerful forces of health and energy act as an invincible armour of defence. How often in the vegetable kingdom, especially observable in agriculture, do we accuse the myriads of insect-life of destroying the plant, when in reality the diseased vegetable is the origin of its own army of scavengers! When our turnip and other crops are eaten up by mildew or green fly, may not the originating cause be a dry and unfavourable season? But from whence do these millions upon millions of germs of insect-life come, if not from the atmosphere, thus showing what powerful—yet invisible and destructive—agents the air we breathe may at all times carry, ready, like the "Constantinople dog," to eat up decay, test the fitness of life, and too often impregnate with the contagion of foot-and-mouth, rinder-pest, typhus, small-pox, and other terrible forms of disease and corruption?

It is, then, to wholesome food, ventilation, and comfort amongst animals, during transit from place to place, added

to cleanliness and disinfection, that we must look for protection against the diseases that human and other flesh is heir to; and until these common laws of Nature are truly and duly obeyed, we must expect to pay the various penalties imposed by negligence and disobedience.

What would be said of the discipline and management of those splendid forms of charity, our Hospitals, Infirmarys, &c., if the beds occupied by patients affected with contagious fevers were never cleansed, disinfected, or removed, but were used for fresh-coming patients with impunity, saturated as they would be with contagious matter? Again, what are we to say of railway, ship, and steam-boat management under similar circumstances? Is it to be expected that healthy cattle are to be crowded and stoved in railway trucks, the holds and decks of ships, that have only a few hours before been tenanted by a mass of diseased animals, and not escape contagion, and thus hand it on to other cargoes, and so on until the whole country becomes infected? These are chief amongst the propagating sources of foot-and-mouth and other contagious diseases, yet how simple and little costly is the best remedy: to cleanse is a mere matter of labour, and to disinfect is only a matter of syringing with a common garden-engine, and with a fluid that would not cost more than a penny per truck for railways, and for the holds and decks of ships probably ten shillings or a pound per voyage. Such disinfectants are supplied by Science, and may be had in any quantity and at the cost I have named: they are mostly constituted of the active principles obtained from products known in Science as "tars." It is true they have this peculiar yet healthy odour, but such is their nature, and it is probable to this may be attributed in some degree their valuable effect; to change this or to deodorise them would be to destroy their intrinsic character altogether.

My Lord, in conclusion I beg to apologise for constituting myself one of a host that daily attack our Government officers with advice gratis or not, as the case may be, and against whose attacks a disinfectant is probably required even more than for our mute and suffering animals,—beast, sheep, &c.,—but I have had bitter and costly experience from foot-and-mouth pleuropneumonia and rinderpest, and shall be only too glad if I can in any way promote the adoption of the best and most permanent remedy, as I am a firm believer that in all cases of disease "Prevention is better than Cure."—I am, &c.,

W. LITTLE.

The Hall, Heckington, Lincolnshire:

LIVERPOOL SODA-TESTS.

To the Editor of the Chemical News.

SIR,—The following circumstances may be, perhaps, of interest to some of your readers as bearing on the high percentage of soda in soda-ash, &c., reported by certain Liverpool trade analysts. During the years 1866 and 1867, I acted as "chemist" to a large alkali works, the majority of the produce of which was tested in Liverpool. My own analyses were uniformly made on the supposition that anhydrous carbonate of sodium contains 58.5 per cent of oxide of sodium ($\text{Na}=23$); that is, the test-acid was so graduated that 100 parts of pure carbonate of sodium neutralised 58.5 volumes of acid. In order to make my results square with those of the Liverpool testers, it was the custom to add from $1\frac{1}{4}$ to $1\frac{3}{4}$ to the percentage found by me, and invoice the substance according to their higher value. For instance, if I found 46.7 per cent, the ash was called 48; if I found 48.1, it was called 50, and so on.

I have letters in my possession which prove that this kind of practice had been in use for years previously; whilst from enquiries I have subsequently made, I am led to believe that the system is still in use, and that in more works than one.

In many works, it is usual to graduate the test-acid on

the supposition that anhydrous carbonate of sodium contains 59.25 per cent of oxide of sodium; that is, 100 parts of carbonate are neutralised by $59\frac{1}{2}$ volumes of acid, the percentage of oxide of sodium in carbonate of sodium being $59\frac{1}{2}$, if Na be assumed = 24. The result of this graduation is that alkalimetric tests made with such acid are $\frac{2}{3}$ of a per cent out of $59\frac{1}{2}$ too high; that is, about one-half of a per cent on a 48 soda-ash. Hence, even on the assumption that $\text{Na}=24$, the increased value allowed by trade custom (applicable in certain districts only) is something like 1 per cent out of 48 less than that found by the Liverpool analysts; or, in other words, the consumer is made to pay for 100 parts of material when he gets less than 98 even in accordance with this trade custom, and whilst actually only about 97 parts are really present.

In former letters to the CHEMICAL NEWS, I have not hesitated to express my opinion on the morality of such proceedings (vol. xvi., 170 and 196), and I have as yet seen no reason for changing my views.—I am, &c.,

CHARLES R. ALDER WRIGHT, D.Sc.

Chemical Laboratory,
St. Mary's Hospital, Paddington.
December 20, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 21, November 22, 1875.

Thermic Researches on Citric Acid.—MM. Berthelot and Louguinine.—The authors conclude that 1 molecule of citric acid dissolved, $\text{C}_{12}\text{H}_8\text{O}_{14}=192$ grms., disengages in presence of 3 equivalents of soda ($\text{NaO}=31$ grms.) an amount of heat almost triple that which 1 molecule of acetic acid would evolve. This is a characteristic property of the tribasic acids, of which 1 molecule is equivalent to 3 monobasic molecules. The three equivalents of soda successively added disengage amounts of heat nearly alike, which signifies that the formation of acid citrates by means of a tribasic citrate and free acid only brings very small quantities of heat into play. The same thing occurs with the acid oxalates, tartrates, acetates, and valerianates, but in these two latter salts the resulting phenomenon is a liberation of heat; whilst in the oxalates, tartrates, and citrates there is a slight absorption. In presence of a suitable quantity of water, the heat disengaged is not notably increased by the presence of an excess of base greater than three equivalents; but the heat varies very sensibly, on the other hand, if this excess of base is employed in more concentrated solutions. This is a result foreseen by theory, for citric acid is a body of mixed function—tribasic acid, and mono-atomic alcohol, $\text{C}_{12}\text{H}_6(\text{H}_2\text{O}_2)(\text{O}_4)_3$. By reason of the stability of tribasic alkaline citrates, citric acid may be titrated in a closely approximate manner by employing baryta and litmus (*Ann. de Chim. et Phys.*, t. lxx., p. 402). The authors examine, further, the behaviour of water with citrates, of citric acid with ammonia, baryta, and with two successive bases; and the action of acids upon citrates.

Remarks on the Interpretation of Two Tables of Chemical Analyses.—M. P. Duchartre.—An examination of the views of M. Violette on the defoliation of the beet-plant, as laid before the session of October 4. The author holds that, under conditions strictly comparable, defoliation reduces the yield of the beet, per hectare, by about one-half, and the net produce of sugar by more than one-third. He announces his intention of showing that this double result is the natural consequence of physiological data.

Electrolysis of Bodies of the Aromatic Series.—M. Goppelsröder.—The author has been occupied with this subject since the end of the last year. The paper of M. Coquillion concerning the direct formation of an aniline-black by the electrolysis of two salts of aniline has induced him to communicate his results. He has observed the formation of an aniline-black obtained directly by the oxidation of aniline by means of electrolytic oxygen. It possesses a metallic lustre like the aniline colours in general, and gives a complete black colouration upon paper. He has turned his attention to the most different groups of the aromatic series, and has discoursed before the Committee of the Industria' Society of Mulhouse on the difficulties presented by the electrolysis of organic bodies, and on the precautions to be taken. He mentions the influence of temperature, of the concentration of the liquid, of the pressure under which electrolysis takes place, and points out the importance of a thorough investigation, the simultaneous employment of electrolysis and dialysis, and on galvanic decomposition in closed vessels under high pressure. Electrolysis does not always give the same results as decomposition by chemical agencies. Instead of employing the electrolytes in a state of isolation, they may be mixed with other bodies, so that in consequence of electrolytic decomposition the radicals of the bodies may act upon each other. He is convinced that electrolysis will yet be employed in dyeing and printing.

Fixation of Atmospheric Nitrogen in Soils.—M. P. Truchot.—The author holds that the proportion of nitrogen in soils is in a direct relation with the quantity of carbon contained in such soils in the form of ulmic compounds, and there is reason to believe with Dehérain that the nitrogen of the atmosphere becomes fixed upon these carbonaceous compounds before concurring in the nutrition of plants.

Water of the Vanne, and Distilled Waters.—M. E. Monier.—The water of this stream, when hot, decomposes only 0.5 to 0.6 milligramme of permanganate per litre.

Construction of Lightning Conductors.—M. E. Saint-Edme.—The author rejects copper and platinum for the points of lightning-rods, and prefers iron coated with nickel.

Formation, Structure, and Decomposition of the Swellings on the Vine caused by the Phylloxera.—M. Max Cornu.—Not adapted for abstraction.

Reactions of the Homologues of Ethylen, which may Explain their Absence in Natural Petroleums.—M. J. A. le Bel.—The products of the reaction of water upon the olefines are almost entirely soluble in water; the higher homologues of the series, commencing with heptylen, yield crystals which deposit in the aqueous stratum, and even in the oil. These bodies are easily destroyed by heat; their decomposition, if once begun, continues spontaneously, and if large quantities are used a formidable explosion results. As the petroleums of America are always found accompanied by a large quantity of water, we may admit that the alterable and non-saturated carbides have been eliminated, and that their products of decomposition have been carried off by the circulation of underground waters, whilst the resins and the saturated hydrocarbons have remained and formed the oils as met with in its natural state.

Remarks in Connection with the Discovery of Gallium.—M. D. Mendeleef.—See page 293.

True Mineralogical and Chemical Place of Troilite.—M. J. Lawrence Smith.—The author finds the composition of carefully chosen specimens to be—

| | |
|-----------------|-------|
| Iron | 63.80 |
| Sulphur | 36.28 |

The specific gravity is 4.813. He considers that troilite, like its companion, schreibersite, is exclusively of meteoric origin.

Defoliation of Beet-Root.—M. Ch. Violette.—A reply to a paper by M. Cl. Bernand (*Comptes Rendus*, tome lxxxi., page 698).

Certain Alterations in Agates and Flints.—M. C. Friedel.—Certain agates from Corrientes (Uruguay) were found chiefly transformed into an earthy mass, perfectly white, sectile, and friable. The author ascribes this change to a partial solution of the more soluble portions of the specimens.

Explosive Compounds: Influence of the Primer on Compressed Gun-Cotton.—MM. P. Champion and Pellet.—The authors object to the English primers, and propose a modification.

MISCELLANEOUS.

South London School of Pharmacy.—The Annual Dinner of the students of this school was held on the 17th inst., at the Horns Assembly Rooms, Kennington. There were 100 students present, besides several gentlemen connected with the institution, and a few visitors, among whom we noticed Messrs. Tyndall, Brown, Ince, Wooton, and Cornish. Dr. Muter, as usual, presided, and gave the toast of the evening—viz., "Success to the S. L. School of Pharmacy," which was heartily responded to, while the tumultuous cheers which greeted the proposal of Dr. Muter's own health by Mr. Barker, of Clifton (an old student), proved his great popularity with his students. During the evening the following medals and certificates of merit were presented:—*Senior Chemistry*—medal, Mr. Hannah; certificate, Mr. Bumpstead. *Junior Chemistry*—medal, Mr. Shepley; certificate, Mr. Brooks. *Botany*—medal, Mr. Hunter and Mr. Kerr; certificates, Mr. Bumpstead and Mr. Fryer, equal. *Materia Medica*—medal, Mr. Kerr; certificate, Mr. Hannah. *Pharmacy*—medal, Mr. Brooks; certificate, Mr. Shepley.

TO CORRESPONDENTS.

E. R.—Consult Wagner's "Chemical Technology," published by Messrs. J. and A. Churchill.

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VOL. XXXII. No. 840.

A NEW PHASE OF ELECTRIC FORCE.

WHILE engaged in electrical experiments, Mr. T. E. Edison, of Newark, U.S., who was one of the first inventors of the quadruplex system of telegraphy, noticed that the accidental contact of a wire with the core of the magnet caused the production of a bright spark when a metallic substance was applied to it. These sparks have frequently been noticed by electricians, but Mr. Edison is the first to enquire into their cause and effect. His investigations have led him to conclude that he has thus discovered a new force to which he has given the name of "Ethereic Force." Its nature may, perhaps, best be explained by comparing it with heat, for like heat, it seems to radiate, but with much greater velocity and to a far greater extent. It passes readily into the human body and also into glass, but apparently prefers metals to other substances. It gives no evidence of polarity, which is so closely identified with all electrical phenomena.

We learn from our friend Dr. G. M. Beard, who has submitted the supposed new force to physiological tests, that it can be obtained from any self-vibrating electro-magnet, or from an electro-magnet operated on by an ordinary Morse key. All that is necessary is to connect a wire to the core of the magnet or any metal in connection with it; or it may be generated by a piece of cadmium or a copper rod surrounded by a helix of wire, placed in a battery circuit, and interrupted by a key. Cadmium is found to answer better than any other metal. Sparks are obtained by the edge of a knife or the end of a lead pencil drawn lightly along the wire or conductor. The spark is the only evidence we have of the existence of this force, there being, at present, no other known phenomenon by which it can be detached or measured. It is supposed that electric force, acting on the apparatus above described, is transformed into this new force, which in turn is transformed into light, and thus we are enabled to detect its presence.

The following mode of producing the sparks is given in the *New York Journal of the Telegraph*:—"Upon an insulated table place an ordinary Morse key and an electro-magnet, the coils of which are so wound that no magnetism is produced in its cores by the passage of an electric current. Use for an armature a piece of the metal cadmium, to one end of which fasten a flat spring. The other end of the spring attach rigidly to a standard fixed on the table. Adjust the armature a short distance away from the core of the magnet. The standard is to be connected by wire to one end of a glass rod or tube, say 2 feet long. The other end of the tube connect by wire with a graphite point (a lead pencil will answer). Another graphite point is connected by wire to a gas-pipe or other suitable mass of metal, not in contact with the apparatus, and the two points, in position similar to the arrangement for producing the electric light, may be placed in a box from which light is excluded, but with a hole in the top for observation. Place 10 or 15 Bunsen cells in circuit with the key and the coils in the usual manner. Now, if the key be closed, a spark of considerable brilliancy will be evolved from the graphite points, but possessing no continuity. If, however (the battery circuit remaining closed), any part of the connection between the gas-pipe and the cadmium is broken, and contacts be made either slowly or rapidly between the

disconnected points, the spark reappears at each contact."

Many experiments have already been made by Mr. Edison and Dr. Beard. The following is a description of one of them in Dr. Beard's own words:—"I stuck a pen-knife in a large block of paraffin, and connected it with the battery, drawing the wire up and down the blade. No sparks appeared. When a long file was substituted for the knife, sparks were abundant, and were kept up as long as the connection was made. Where, then, did the power go to? Into the air? or the earth? I suspended then by silk rolls of wire of various sizes, and allowed them to strike against the connection. With small coils sparks rarely appeared; with the larger coils they were abundant. It would seem, therefore, that a certain size is necessary in the conductor in order to get the sparks. At one time we led the wire through a large vessel filled with water, and pieces of iron and bars of iron of various sizes were placed across its track and resting upon the wire, and the wire was wound round an iron press, and yet at the end the spark appeared. Mr. Edison took the wire out of doors, ran it along the ground and in a ditch on a rainy night, and brought it up stairs several rods from the battery, and the spark was seen by him, by his assistant, and by myself in a dark box; but it was not constant, and required a nice adjustment of the carbon points to bring it out."

The evidences that the force indicated by the sparks coming from the apparatus above described is a new form of electricity not generally recognised, are:—

First. It gives no evidence of polarity, and cannot by known laws of electricity complete a circuit, and it does not decompose iodide of potassium, a test, as all electricians know, of exceeding delicacy. Mr. Edison says that he passed the force through iodised paper for three hours, and no effect was produced.

Second. It has no demonstrable physiological effects. Electricity of any form, giving such a spark as this, would be felt on the tip of the tongue if touched lightly, even if no other physiological effects were appreciated. A current from 2500 very small water cells is of such small quantity and high potential that it is little if at all felt on the tongue, as Prof. J. E. Smith tells us, but such a current would at once respond to other tests of electricity.

Third. It will pass through insulators better than electricity. A dry hollow glass tube, half an inch in diameter and 2 feet long, does not prevent the passage of the force, showing that it is not easily insulated. The spark weakens, however, after the force has passed through the rod, just as after it has passed through the body. In these tests the spark is studied at the point of contact of the sharpened ends of lead pencils enclosed in a dark box with a small hole in the top.

Fourth. It does not charge a Leyden jar nor deflect the needle of Thomson's mirror galvanometer. Mr. Edison tested these instruments by the force many times, and has performed the experiments in Dr. Beard's presence.

Fifth. The spark that comes from it resembles in appearance the spark that comes from dynamic electricity, and not the spark of inductive electricity, in a state of high potential. It scintillates, and does not jump through the air, but requires actual contact, and in that respect differs from the spark of inductive electricity. If it were inductive electricity at high potential it would jump through the air.

In a letter dated December 11th, Dr. Beard promises to send us more details in a few days. We hope, therefore, to give in an early number the results of further experiments together with an illustrated description of the apparatus employed by Mr. Edison. His investigation will probably lead to great practical results. Our thanks are certainly due to him for having opened a new field for scientific research.

THE NATURE AND LAWS OF CHEMICAL ACTION.

By E. VOGEL, San Francisco.

It is a well established fact of organic chemistry that when 2 or more molecules of carbon ($C=12$) unite to form one co. molecule, the equivalence of the compound is less than the sum of the equivalences of the single molecules, $C=4H$, $C_2=6H$, $C_3=8H$. . . $C_n=2n+2H$, instead of $C_n=4nH$.

If 2 molecules of fluorine ($Fl=19$) combine in the same manner,—

$$\begin{array}{r} 1=19-1 \\ 1=19-1 \\ \hline 2=38-2 \end{array}$$

the compound $1=36$ is very near that of chlorine ($Cl=35.5$). If 2 molecules of Cl combine with 1 Fl , the loss of equivalence being 4 for each Cl , and one on each side for the Fl molecule—

$$\begin{array}{r} 1=35.5-4 \quad 1=63-1 \\ 1=35.5-4 \quad 1=19-1 \\ \hline 2=71.0-8 \quad 2=82-2 \end{array}$$

the result is 1 bromine molecule, $Br=80$. 2 molecules of $1=63$ combining with 1 Fl , the loss of equivalence being proportional to the numbers—

$$\begin{array}{r} 1=63-8 \quad 1=110-1 \\ 1=63-8 \quad 1=19-1 \\ \hline 2=126-16 \quad 2=129-2 \end{array}$$

the iodine molecule is obtained, $I=127$.

Considering the great chemical resemblance of the members of this natural group of elements, the evidence of their being compounds of fluorine is almost conclusive.

The discovery of these numerical relations is, however, not a result of accident. Their existence has been derived from conclusions based on the fact of a close connection between the spectral lines of the solar metals and their atomic weights. The main features of this connection are*—(1) That the distances of the H lines of the solar spectrum follow each other at the rate of squares: (2) that the lines of shortest waves of the solar metals express very nearly their atomic weights. On the foundation of these facts I have arrived at the conclusion that the H molecules, and consequently molecules generally, are composed of numerous atomic but exclusively ponderable constituents, in each case grouped around a common centre, and held together by no other force than that of gravitation.

By accepting this view of the inner constitution of matter, the following constant relations between distance, force, mass, and density are established as necessary consequences of the universal law of gravitation:—

(1.) Attraction decreases in proportion to the increase of the squares of distances, and consequently increases at the rate of the squares of approximation, reaching a maximum when the approximation is complete. Force and distance are inversely proportional. The sum of the distances at which the constituents of a body maintain each other by mutual attraction is its volume. The general measure of the attractive force is the weight of volume. If $vol.=v$, $weight=p$, their constant relation is—

$$v=p^2; p=Vv.$$

(2.) Extreme divisibility is the consequence of the atomic composition of matter. The maximum of force coinciding with the minimum of space, mass and force are inversely proportional; consequently weight, as a measure of force, increases with the decrease of mass.

(3.) Density expresses the relation of the number of constituents to their volume. It increases with the decrease of volume, and is a maximum $=1$, when $vol.$ a minimum $=1$. Volume increasing with mass, density and mass are inversely proportional.

(4.) Density and number of constituent particles are directly proportional, $v=vol.$; $m=mass$; $d=density$ —

$$v=m^2; m=Vv; d=\frac{m}{v}=\frac{m}{m^2}=\frac{1}{m}.$$

If chemical affinity and gravitation are identical forces, the laws of chemical action are determined by these relations.

The subject of chemical action involves the consideration of the nature of the expansive energy of gases.

The hypothesis of an imponderable ether, whose atoms repel each other and are connected with the movements of ponderable atoms, seems wholly inadmissible. Two atoms, in order to attract each other, must have firm supports—a capacity for offering resistance or overcoming the resistance of an opposing force. Without the power of resistance no display of force seems imaginable. Both attraction and repulsion pre-suppose the presence and contest of two forces, one tending to unite, the other to hold apart two distinct objects, attraction or repulsion ensuing as one force predominates over the other. Imponderable atoms can offer no resistance, and therefore neither attract nor repel each other; much less can they ever exercise any influence on ponderable particles.

Gravitation being common to all matter, gas molecules must attract each other with a force directly proportional to the diminution of their individual mass. The molecules of a gas being all exactly alike, the mutuality of their attraction will prevent the formation of larger compounds. The smallest nucleus that may have formed will attract other molecules from all sides; their forces combining as they approach, outweigh largely those of the nucleus; and the inner condition of gases must be that of a most lively contest among all the molecules, in incessantly approaching and receding from each other—a condition which has long been disclosed from the physical properties of gases; and the velocities of molecules have been found to be extraordinary; those of the H molecules, for instance, at the temperature of the freezing-point, seventeen miles per minute.

The knowledge of the identity of gravitation and expansive force of gases affords an insight into the cause of the gaseous state. Attraction cannot be otherwise than the result of an inequality of forces, and, between identical molecules, is possible only in consequence of a disturbance of the equilibrium of the molecular forces, which supposes a partial displacement of the molecular constituents.

The composition of molecules is either, more or less, simple or compound; atoms unite to form molecules of the first order; aggregates of these combine to larger molecules: molecules of different substances unite to form the molecule of a new substance, and so on. The attractive force being most intense in the molecules of smallest mass, a displacement of their component particles is proportionately difficult, and the gaseous state, therefore, the more perfect the lighter the weight of volume, the volume of gases being thus directly proportional to the smallness and density of their molecules.

In compound molecules the attractive force decreases with the distance from the centre. When by increase of temperature the velocities of co. gas molecules, and the force with which, in colliding, they strike each other, are considerably increased, the effect of the impetus may prove stronger than the force which binds the outer molecular layers; their constituents will then be forced from their natural positions, and, while scattering more or less in radial directions, be exposed to appropriation by neighbouring molecules just happening to strike them. The union of identical molecules is thus accomplished.

Aggregation, liquefaction, and solidification are conse-

* See particulars in *Scientific American* of Nov. 27, "Relation between Spectral Lines and Atomic Weights."

quently the effect of mass; and the gaseous state, the resistance to condensation, decomposition, and fusion, are indications of great density. These being the characteristics of all elementary substances, some idea can be formed of their origin or the conditions of their formation. The density of their molecules resisting the action of all known terrestrial agents, the constituents must have existed far removed from the general effect of the gravitation of the planetary mass, either as gases in high altitudes of the atmosphere, or must have originated on other heavenly bodies of much smaller mass.

The effect of the velocities of molecules represents the sum of the attractive forces contained in a given volume of gas, and is its expansive energy.

Molecular density or elasticity is directly proportional to the gas volume, and so is density to the number of molecules; the relation between number of molecules and volume is, therefore, not a constant one, but changes

as $\frac{1}{m}$; and the law of Avogadro—"equal volumes of gases contain equal numbers of molecules"—is incorrect. This law, although the corner-stone of modern chemistry, has never been firmly established, but found at variance with important physical and chemical facts. Its fallacy is proven by the relation which has been established, by the mechanical theory of gases, to exist between volume and specific gravity, to the effect that the velocities of gas molecules are inversely proportional to the square roots of the weights of volume, which is the same relation $= \frac{1}{m}$, deduced by me from the general law of gravitation.

As already shown, the value of the square roots increases with the decrease of volume; and it is evident that the velocity of gas molecules is equivalent to their elasticity, and this to the volume.

The discrepancies of Avogadro's law are due to the same causes as those of Mariotte's—to condensation, dissociation, or decomposition. All these changes are the result of compression, for increase of temperature at constant volume is but another mode of compression, and the pressure of a surrounding colder medium produces in all cases of increase of temperature an effect more or less approaching to constancy of volume. The result of condensation or decomposition depends on the quantity of the individual molecular mass. The exceptional behaviour of H, increasing in volume under great pressure, while that of all other gases, under the same circumstances, decreases, can only be accounted for by disintegration or dissociation of the H molecules, all other gases undergoing partial condensation.

The extent of the disintegration of gaseous aggregates is illustrated by the vapour of sulphur, 1 volume of which weighs—

| | | | |
|---------------------|------|-------|-----------------|
| At a temperature of | 500° | 96=3, | density=0.58. |
| " | " | 600° | 72=2½, " =0.67. |
| " | " | 700° | 40=1½, " =0.91. |
| " | " | 860° | 32=1, " =1.00. |

The density of the volume weighing 32, consequently the number of molecules contained in it is $\frac{1.00}{0.58}$, or nearly twice the number contained in the volume weighing 96.

Condensation by increase of temperature seems well illustrated by the occurrence of frequent showers in a warm, moist atmosphere. Solar radiation must, of necessity, constantly reduce water vapour to a more gaseous state. The greater tension of this gas will finally either overcome the resistance of the surrounding more ponderous masses of vapour, or these breaking in upon and mixing with it, condensation is effected by means of the greater density of the finer constituents. The liberation of heat attending condensation adds to the effect of new insolation, and the frequency of the phenomenon is the result.

The law of Avogadro, as also that of Boyle or Mariotte

holds good for identical substances as long as there is no change in the nature or state of the latter; and if expansive energy of gases, gravitation of matter, and chemical affinity are identical forces, the chemical union of identical substances must take place in conformity to Mariotte's law, while that of different substances is the function of density.

The co. molecules of C and Fl are examples of identical masses chemically united. The attractive force has, in these cases, the same effect as mechanical compression; its amount being that of 1 molecule, and the effect at each increase of 1 a reduction of volume amounting to one-half of a molecular volume. The relations between increase of mass and volume are consequently—

$$\begin{aligned} C &= 4H. \\ C_2 &= 4 + \frac{1}{2} = 6H. \\ C_3 &= 6 + \frac{1}{3} = 8H. \\ C_4 &= 8 + \frac{1}{4} = 10H. \\ C_5 &= 10 + \frac{1}{5} = 12H. \end{aligned}$$

To the number of molecules 2, 3, 4, 5 corresponds a diminution of the increase of volume at the rate of $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}$, which is the simple relation of Mariotte's law.

In the compound C_3 2 molecules bind a third, and the total reduction of volume is $3 \times 4 = 12 - 8 = 4$. If the attractive force were doubled, and that of 2 molecules, the reduction of volume would be $2 \times 4 = 8$, and this is the rate of loss of equivalence when 2Cl combine. In the molecule C_5 4 molecules bind one in addition, the reduction of volume being $20 - 12 = 8$. It would be $2 \times 8 = 16$ if the attractive force were doubled, which is the case in the compound of $1=63$, forming the base of the I molecule.

That density is the active principle of chemical affinity, and that the gaseous elements and Br and I, their compounds, also C, are the densest bodies, is proven by the general fact that they combine with all other elements. The remarkable multiplicity of properties exhibited by organic bodies composed of the densest element finds thus a natural ground of explanation. H being the densest, and heading the list of elementary substances, the concluding link, K, must be the lightest; its specific gravity is, indeed, only $H=1.00$, $K=0.16$ (water = 1.00, $K=0.86$), H and K do not unite directly, on account of the disproportion of the mass of the H to that of the K molecule.

The multiple proportions of chemical combinations are, density being the active chemical principle, multiple of density, and, if this is made the measure of pressure, the condensations consequent on chemical union correspond to Mariotte's law.

The volume weight of H is =1, that of O =16; their densities are consequently $1.00:0.25=4:1$. $4-1=3$ is the increase of force or pressure when the two elements react on each other, the reduction of volume or mass,

consequently, $\frac{17}{3}=5\frac{2}{3}$; $1+\frac{1}{4}=\frac{5}{4}$ is the increase of mass, that is, $\frac{17}{5}=3\frac{2}{5}$. The sum of reduction and increase,

$5\frac{2}{3}+3\frac{2}{5}$, is (within the fraction of $\frac{1}{15}$ th) =9, the volume weight of water, which is the product of the union.

1H, combining with 8O, unites with Fl 9.50, $d=0.324$; Cl 17.75, $d=0.237$; Br 40, $d=0.158$; I 63.5, $d=0.125$. The densities of these masses are to the unit H as $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$.

In kalium hydroxide the densities are multiple, if the composition is $H_2K_2(2 \times 19.50=39)O(=8)$.

$$\begin{aligned} \text{Densities—} &0.70, 0.16 \quad . \quad . \quad . \quad 0.35 \\ &0.70=2 \times 0.35 \\ &0.35=2 \times 0.16 \end{aligned}$$

In natrium hydroxide, if the composition is—
 $HNa(=11.50)O(=8)$.

$$\begin{aligned} \text{Densities—} &1.00, 0.30 \quad . \quad . \quad . \quad 0.35 \\ &1.00=3 \times 0.35-5 \\ &0.35=0.30+5. \end{aligned}$$

ON A COLORIMETRIC METHOD FOR DETERMINING SMALL QUANTITIES OF COPPER.*

By THOMAS CARNELLEY, B.Sc., F.C.S.,

Demonstrator in the Chemical Laboratory of Owens College.

LAST year I brought before this Society a paper (*Proceedings*, vol. xiv., 2) on a colorimetric method for determining iron in waters, and as this method has been found convenient for estimating small quantities of iron in substances other than water,† I thought it would likewise be useful to have a delicate and easy method of a similar kind for copper, and it is the description of such a method that forms the subject of the present paper.

The reagent used is the same as in the case of iron, viz., potassium ferrocyanide, which gives a purple-brown colour with very dilute solutions of copper. This reaction, however, is not so delicate as it is with iron, for 1 part of the latter in 13,000,000 parts of water can be detected by means of potassium ferrocyanide, while 1 part of copper in a neutral solution, containing ammonium nitrate, can be easily detected in only 2,500,000 parts of water. Of the coloured reactions which copper gives with different reagents, those with sulphuretted hydrogen and potassium ferrocyanide are by far the most delicate, and as a preliminary the comparative values of these two reagents were tested, with the following results, the determination being made in each case in 150 c.c. of water:—

(1.) *With H₂S.* 1 part of copper produces a colour in 2,500,000 parts of water.

(2.) *With K₄FeCy₆.*

(a.) In acid solutions, the colour produced being earthy brown, 1 part of copper produces a colour in 1,000,000 parts of water.

(b.) In neutral solutions, the colour being purple-brown, 1 part of copper produces a colour in 1,500,000 parts of water.

(c.) In neutral solutions containing ammonium nitrate, the colour being purple-brown, 1 part of copper produces a colour in 2,500,000 parts of water.

From the above it will be seen that of the two reagents sulphuretted hydrogen is the more delicate, except in the latter case, when they are of equal value. But potassium ferrocyanide has a decided advantage over sulphuretted hydrogen in the fact that lead, when not present in too large quantity, does not interfere with the depth of colour obtained, whereas to sulphuretted hydrogen it is, as is well known, very sensitive.

And though iron if present would, without special precaution being taken, prevent the determination of copper by means of potassium ferrocyanide, yet by the method as described below the amounts of these metals contained together in a solution can be estimated by this reagent.

As the above results show, ammonium nitrate renders the reaction much more delicate; other salts, as ammonium chloride and potassium nitrate, have likewise the same effect.

The method of analysis consists in the comparison of the purple-brown colours produced by adding to a solution of potassium ferrocyanide—first, a solution of copper of known strength, and secondly, the solution in which the copper is to be determined.

The solutions and materials required are as follows:—

(1.) *Standard copper solution.*—Prepared by dissolving 0.393 grm. of pure CuSO₄.5H₂O in one litre of water. 1 c.c. is then equivalent to 0.1 m.grm. Cu.

(2.) *Solution of ammonium nitrate.*—Made by dissolving 100 grms. of the salt in one litre of water.

(3.) *Potassium ferrocyanide solution.*—Containing 1 part of the salt in 25 parts of water.

(4.) *Two glass cylinders* holding rather more than 150 c.c. each, the point equivalent to that volume being marked on the glass. They must, of course, both be of the same tint and as nearly colourless as possible.

(5.) *A burette*, marked to $\frac{1}{10}$ c.c., for the copper solution: a 5 c.c. pipette for the ammonium nitrate, and a small tube to deliver the potassium ferrocyanide in drops.

The following is the method of analysis:—Five drops of the potassium ferrocyanide are placed in each cylinder, and then a measured quantity of the neutral solution in which the copper is to be determined into one of them (A), and both filled up to the mark with distilled water, 5 c.c. of the ammonium nitrate solution added to each, and then the standard copper solution runs gradually into (B), till the colours in both cylinders are of the same depth, the liquid being well stirred after each addition. The number of cubic centimetres used are then read off. Each cubic centimetre corresponds to 0.1 m.grm. of copper, from which the amount of copper in the solution in question can be calculated.

The solution in which the copper is to be estimated must be neutral, for if it contains free acid the latter lessens the depth of colour and changes it from a purple brown to an earthy brown. If it should be acid it is rendered slightly alkaline with ammonia, and the excess of the latter got rid of by boiling. The solution must not be alkaline, as the brown coloration is soluble in ammonia and decomposed by potash; if it is alkaline from ammonia this is remedied as before by boiling it off; while free potash, should it be present, is neutralised by an acid and the latter by ammonia.

Within moderate limits the amount of potassium ferrocyanide does not affect the accuracy of the method, as was proved by several experiments, for instance, when $\frac{1}{2}$ c.c. and 2 c.c. of the ferrocyanide were added to the two cylinders respectively, water up to the mark, and 5 c.c. of ammonium nitrate to each, then 7 c.c. of the standard copper solution produced in each an equal depth in colour.

The same may be said of the ammonium nitrate, for in one of several trials, all leading to the same result, when there were five drops of ferrocyanide in each cylinder, with water up to the mark, and 5 c.c. of ammonium nitrate in one and 15 c.c. in the other, an equal depth of colour was obtained on running into each 7 c.c. of the standard copper solution.

The following are the results obtained by estimating the copper in pure solutions of copper sulphate of known strength:—

| Copper found. | Copper calculated. |
|----------------|--------------------|
| 205.000 m.grm. | 202.080 m.grm. |
| 32.360 " | 31.320 " |
| 6.500 " | 6.270 " |
| 1.180 " | 1.130 " |
| 1.130 " | 1.210 " |
| 0.960 " | 1.010 " |
| 0.750 " | 0.750 " |
| 0.590 " | 0.610 " |
| 0.520 " | 0.500 " |
| 0.420 " | 0.400 " |
| 0.390 " | 0.380 " |
| 0.220 " | 0.200 " |
| 0.130 " | 0.130 " |
| 0.120 " | 0.100 " |
| 0.055 " | 0.050 " |

In order to test the effect which the different salts might have on the accuracy of the method, 8.0 grms. of a mixture of the following salts, viz.:—Ammonium chloride, sodium chloride, potassium nitrate, calcium chloride, calcium sulphate, and magnesium sulphate, were dissolved with an amount of copper sulphate, containing 0.101 grm. Cu. to 1 litre. Varying quantities of this solution were taken, and the copper estimated therein with the following results, from which it is seen that these salts have no detrimental effect:—

* A Paper read before the Manchester Literary and Philosophical Society.

† Among others I may mention that use has been made of this method by Wanklyn, in the indirect determination of alum in bread.—CHEMICAL NEWS, vol. xxii., p. 67.

| Copper found. | Copper calculated. |
|---------------|--------------------|
| 0.54 m.grm. | 0.51 m.grm. |
| 0.71 „ | 0.71 „ |
| 0.91 „ | 0.91 „ |

In the same manner the effect of the presence of colourless non-volatile organic matter was tested by dissolving up 13 grms. of sugar with an amount of copper sulphate equivalent to 0.0505 gm. copper in 1 litre of water, and the copper estimated in two different portions as before, the following numbers being obtained:—

| Copper found. | Copper calculated. |
|---------------|--------------------|
| 0.52 m.grm. | 0.51 m.grm. |
| 0.82 „ | 0.81 „ |

In order to see what influence the presence of lead might exercise on this method of estimating copper, a quantity of the sulphate containing 0.255 gm. Cu was dissolved in water, the copper precipitated by potash, washed, and the oxide dissolved in nitric acid and the solution after nearly neutralising with ammonia diluted to 1 litre with the addition of 2 grms. of lead nitrate = 1.25 grms. Pb. Varying quantities of this solution were taken, and the copper in them estimated with the following results:—

| Copper found. | Copper calculated. |
|---------------|--------------------|
| 0.80 m.grm. | 0.77 m.grm. |
| 0.75 „ | 0.70 „ |
| 0.51 „ | 0.49 „ |
| 0.49 „ | 0.51 „ |
| 0.38 „ | 0.35 „ |

From which it will be seen that lead when present in not too large quantity has little or no effect on the accuracy of the method. The precipitate obtained on adding potassium ferrocyanide to a lead salt is white, and this, except when present in comparatively large quantity with respect to the copper, does not interfere with the comparison of the colours. In the above experiments the proportion of lead to copper was as 5 to 1.

When copper is to be estimated in a solution containing iron the following is the method of procedure to be adopted. To the solution a few drops of nitric acid are added in order to oxidise the iron, the liquid evaporated to a small bulk, and the iron precipitated by ammonia. Even when very small quantities of iron are present this can be done easily and completely if there is only a very small quantity of fluid. The precipitate of ferric oxide is then filtered off, washed once, dissolved in nitric acid and re-precipitated by ammonia, filtered, and washed. The iron precipitate is now free from copper, and in it the iron can be estimated by dissolving in nitric acid, making the solution nearly neutral with ammonia and determining the iron by the method given in the paper before referred to. The filtrate from the iron precipitate is boiled till all the ammonia is completely driven off, and the copper estimated in the solution so obtained as already described. The following are the results obtained with solutions containing known quantities of iron and copper:—

| Copper. | | Iron. | |
|-----------------|-------------|--------|-------------|
| Found. | Calculated. | Found. | Calculated. |
| (1) 0.53 m.grm. | 0.51 m.grm. | 0.22 | 0.20 m.grm. |
| (2) 0.69 „ | 0.61 „ | 2.15 | 2.40 „ |
| (3) 0.79 „ | 0.76 „ | 2.42 | 3.00 „ |
| (4) 0.66 „ | 0.66 | — | — |

When the solution containing copper is too dilute to give any colouration directly with potassium ferrocyanide, a measured quantity of it must be evaporated to a small bulk and filtered if necessary, and if it contains iron, also treated as already described.

In the determination of copper and iron in water, for which the method is specially applicable, a measured quantity is evaporated with a few drops of nitric acid to dryness, ignited to get rid of any organic matter that

might colour the liquid, and dissolved in a little boiling water and a drop or two of nitric acid, if it is not all soluble it does not matter; ammonia is next added to precipitate the iron, the latter filtered off, washed, re-dissolved in nitric acid, and again precipitated by ammonia, filtered off, and washed. The filtrate is added to the one previously obtained, and the iron estimated in the precipitate and the copper in the united filtrate.

The distilled water used in the Owens College Laboratory, and which is condensed by the apparatus made by Hirzel, of Leipzig, gave, on analysis by the above method, the following results, two litres of the water being used for the purpose:—

0.15 parts Cu } in 1,000,000 parts of water.
0.03 parts Fe }

The copper and iron in this case were evidently derived from the fittings of the condensing apparatus, which consisted in great part of these metals.

NOTE ON THE CHALYBEATE WATER AT SELLAFIELD, NEAR WHITEHAVEN.

By WILLIAM H. WATSON.

WHEN I published my examination of the chalybeate spring at Sellafield, near Whitehaven (CHEM. NEWS, xxxi., 11), I was unable to offer any idea as to the origin of the water or from whence it obtained its solid constituents. Since then I have been able to trace it, and find that the spring is supplied chiefly by drainage from fields in its immediate vicinity and partly by a small drain from a pond about half a mile distant. The water has to percolate through several yards of earth, which at about 5 feet from the surface and extending to a considerable depth below consists of a clayey soil containing both ferrous and manganous oxide, thus clearly indicating the origin of the chalybeate nature of the water previously analysed.

I append an analysis of a portion of the clayey earth dried at 212°.

| | |
|------------------------------|--------|
| Silica | 40.24 |
| Alumina | 38.62 |
| Ferrous oxide | 10.73 |
| Manganous oxide | 0.70 |
| Calcium carbonate | 5.30 |
| Calcium sulphate | 2.05 |
| Loss or undetermined | 0.36 |
| | 100.00 |

ON SOME PRELIMINARY RESEARCHES ON THE ACTION OF METALLIC MAGNESIUM ON CERTAIN METALLIC SALTS.

By SERGIUS KERN, St. Petersburg.

DR. J. H. GLADSTONE's very interesting paper on the copper-zinc couple inserted in the CHEMICAL NEWS, vol. xxxii., p. 195, gave me an idea to try the action of metallic magnesium on the aqueous solutions of certain metallic salts. The first salt which I took was cobalt chloride; the results of the experiments are as follows:—

A concentrated solution of cobalt chloride in water, with a piece of magnesium-ribbon, was placed into a tall glass. Evolution of hydrogen immediately commenced, and the solution was left to stand quietly in the laboratory for about a week; it was observed then that the evolution of hydrogen was nearly finished, and the solution was of a light rose colour. The magnesium ribbon during the experiments fell into pieces and was covered with a green mass. The solution was then stirred by means of a glass

rod, and all the green mass fell down in the form of a precipitate, which was filtered from the liquor, washed, and dried over sulphuric acid. This peculiar precipitate was carefully examined as will be further explained.

From the remaining solution the excess of cobalt chloride was precipitated by $(\text{NH}_4)_2\text{S}$ in the form of cobalt sulphide. The CoS was filtered, and the clear solution obtained was tested for magnesium salts in case they were present; analysis showed the presence of this metal, so that a solution of sodium phosphate (HNa_2PO_4), with the addition of ammonia, gave in the analysed liquid a precipitate of $(\text{MgNH}_4\text{PO}_4)$. The green mass examined under the microscope showed the presence of small pieces of undissolved magnesium, but most of the mass precipitated consisted of a green amorphous powder, which gives the following reactions:—

- (1.) It is insoluble in water and alcohol.
- (2.) With nitric acid it gives cobalt nitrate ($\text{Co}(\text{NO}_3)_2$).
- (3.) Sulphuric acid yields the corresponding salt.
- (4.) Ammonia colours it brown.

The substance was heated in a test-tube with sulphuric acid in order to obtain free hydrochloric acid in case chlorine were present in the green mass. Reagents showed the absence of chlorine.

This substance was found to contain a considerable amount of cobalt monoxide (CoO); it is formed during the experiments by the following reactions:—



This equation explains well, I suppose, the action of metallic magnesium on cobalt chloride.

When magnesium is thrown into a solution of silver nitrate, this salt is very quickly decomposed, with the formation of silver oxide (Ag_2O).

I conclude this short notice by remarking that Dr. Gladstone's new work opens to the chemist a new and very valuable method for chemical investigations.

ON A SIMPLE APPARATUS FOR THE ESTIMATION OF TANNIC ACID BY THE METHOD OF MÜNTZ AND RAMSPACHER.

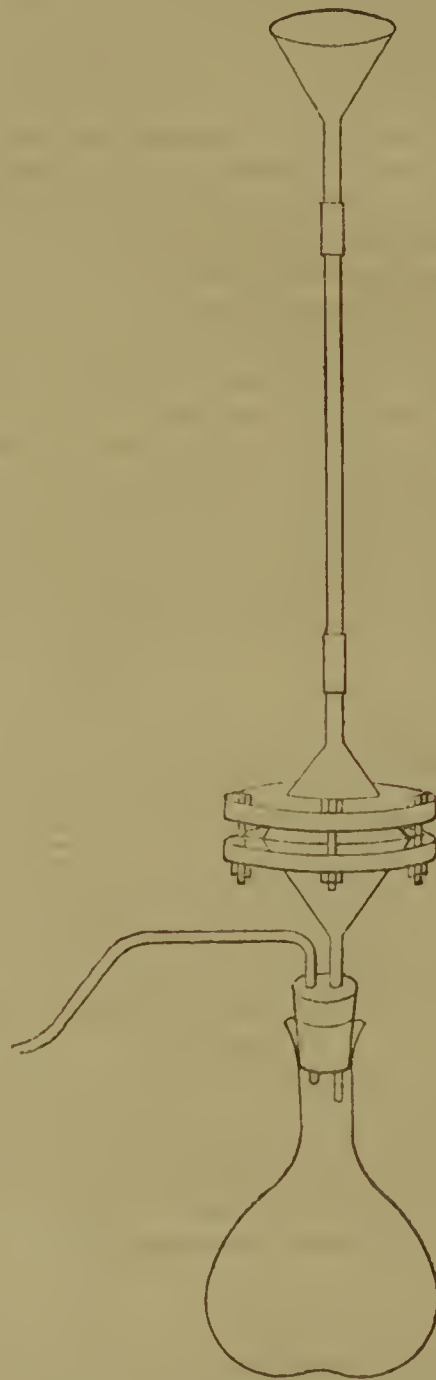
By WILLIAM THOMSON, F.C.S.

THE method devised by Müntz and Ramspacher* is based on the fact that when a solution containing tannic acid is forced through well washed untanned hide, that the hide fixes all the tannic acid and practically allows the other matters which may be in solution to pass without being absorbed. The difference, therefore, between the specific gravities of the solution before and after passing through the hide indicates, by reference to a table, the percentage of tannin originally contained in the solution. The apparatus described by Müntz and Ramspacher is expensive, and the time required to have one constructed would no doubt be considerable, so that it would not be worth while for chemists who have not a somewhat regular practice in the analysis of tannin materials to go to the trouble or expense of having such an apparatus made. The principle of their contrivance consists in enclosing the fluid to be tested in a short metallic cylinder open at both ends, the under end being covered by a piece of the untanned hide, the upper by a strong piece of vulcanised sheet caoutchouc. These are clamped firmly together by screws, and by means of a screw to which is attached a rounded metallic disc pressure is brought to bear on the caoutchouc, and the fluid thus forced through the hide.

The contrivance which I have devised for this purpose, which answers perfectly, and may be made altogether in about an hour, is the following:—

Two strong ground-glass funnels with rather wide stems are taken, a circular piece of hard wood fitted on

each (as shown in the drawing), the bottom part of which comes within the eighth of an inch from the top of the funnel; four holes are made through the wood, into which are inserted four ordinary long iron screws fitted with nuts; the hide is placed between the two funnels, the screws passed through the holes in the two pieces of wood, the nuts screwed on and tightened equally all round by a key; a funnel with a thin stem is then inserted into the larger stem of the top funnel and the liquor poured in; the stem of the under funnel is passed through an india-rubber cork fitted into a flask; the flask is



attached by another tube penetrating the cork to a Bunsen's vacuum pump, and vacuum made and the liquor allowed to filter slowly through. Quicker filtration may be produced by applying pressure above and suction below, by completely filling the upper funnel with liquid, attaching to its stem by strong caoutchouc tubing a long tube ending in another funnel (as shown in the engraving) and filling the tube and upper funnel with liquid; or the pressure by this means may alone be employed.

Royal Institution, Manchester,
December 10, 1875.

Letts's Diaries.—According to their usual custom, Letts, Son, and Co. (Lim.) have issued a series of Diaries for the year 1876. To meet the requirements of all classes and professions, they seem each year to add to their already long list. The "Medical Diary," the "Appointment Diary," and the Commercial "Tablet Diary" are especially useful. A new feature of the Office Editions of these Diaries is the Lists of Provincial and Colonial and Foreign Post Towns, their distance from London (or Dublin), Market Days, Names of Bankers, and their London Agents, Number of Postal Deliveries and Despatches, &c.

* *Annales de Chimie et de Physique*, September, 1875, p. 86.

ULTRAMARINE: ITS FORMATION DURING THE INCINERATION OF BREAD.

By JAMES EDMUNDS, M.D., M.R.C.P.,
Medical Officer of Health, and Public Analyst for St. James's,
Westminster.

I DO not find any note of the fact that, at a certain stage in the incineration of bread, the beautiful ultramarine blue is formed. This occurs under circumstances which I have not yet sufficiently studied to enable me to reproduce it with certainty; but, if the heat be raised to very bright redness or be prolonged after complete incineration of the bread, the blue passes into a beautiful turquoise colour, then becomes green, then passes on into a rusty colour, and finally comes out as a pale fawn-coloured lining to the botryoidal mass of ash. This is not further affected, even by a prolonged white heat. The tints are so suggestive of the presence of copper that only by very careful examination did I satisfy myself of the absence of that metal; and I find that the colours occur in the purest and finest bread, as well as in inferior samples. I should be grateful if other analysts would favour me with any observations which they may have made upon this point, and I hope soon to be in a position to submit for myself some further account.

It is curious that copper should appear in all the textbooks as one of the agents ordinarily used for adulterating bread, and the question arises whether the supposed use of copper may not sometimes have been erroneously inferred from the occurrence in bread-ash of these beautiful colours.

5, Savile Row, London,
December 10, 1875.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;
Professor of Chemistry in the College of the London Hospital; late
Medical Officer of Health and Public Analyst for the City
of London; and President of the Society of
Medical Officers of Health.

(Concluded from page 297).

THE last of the acid nuisances to which I shall refer is that caused by the manufacture of *superphosphate of lime*. In the early days of this branch of industry, it was the practice to make superphosphate of lime by mixing chamber acid a little diluted with water, with ground coprolites, bones, and animal refuse of all kinds, by means of a shovel and an open trough. The fumes of acid gases and vapours which were thus freely evolved into the air were extremely offensive to the neighbourhood. At present the mixture is effected in a closed vessel in which a stirrer revolves horizontally. The best form of mixer is about 10 feet long and 4 feet in diameter. The materials which are used in the manufacture are ground coprolites, crushed bones, spent animal charcoal from sugar refineries, and animal refuse of all kinds. These are put into the mixer in proper proportions, and treated with water and sulphuric acid. The mixer has an upper opening for the admission of the materials, and a lower one for the exit of them. Both of these openings are secured with air-tight valves; and during the mixing, which lasts from five to ten minutes, the materials evolve vapours charged with organic fumes as well as the acid, and exceedingly irritating tetrafluoride of silicon, which is produced by the action of sulphuric acid upon the fluorides and silicates

contained in the coprolites. These gases and vapours are conveyed from the mixer by a special shaft or flue which carries them first to a chamber, in which they meet a copious spray of water, and then through a coke scrubber or condenser supplied with a stream of water; and lastly, in some cases, through a lime purifier before they reach the furnace shaft. When the materials are thoroughly incorporated in the mixer, they are discharged through the lower opening into the chamber or den, in which, in the course of twenty-four hours, they consolidate. This chamber should also be air-tight, and ventilated into the same shaft or flue which carries the gases from the mixer to the condenser. If these operations are properly managed, they may be conducted without other offence to the neighbourhood than the faint acid smell which is inseparable from the exposure of the consolidated superphosphate; but if they are not well designed and managed, they are the cause of insufferable nuisance. The object of having a fine spray of water as the first absorbent of the acid gases is that the tetrafluoride of silicon is immediately decomposed when it comes into contact with water, forming hydrate of silica, which is deposited in a pulpy form, and an acid called hydro-fluosilicic acid, which the water dissolves. Now, if this were to take place in a scrubber packed with coke and supplied with downward flowing water, this hydrate of silica would soon clog the pores and apertures of the scrubber, and throw it out of action. Hence the necessity for decomposing the tetrafluoride of silicon in a chamber before it reaches the coke scrubber.

And now, in concluding this brief outline of the processes which are most likely to receive attention from Medical Officers of Health, I may summarise the recommendations which I have ventured to submit as the best means of abating the nuisances referred to by saying:—

First, that all noxious and offensive operations should be carried on, as far as possible, in air-tight chambers, which can be ventilated by means of fans, or by the chimney draft.

Second, that all condensible and absorbable gases and vapours should be passed through condensers and absorbents best suited for their absorption—as water in spray, and scrubbers charged with water, oil of vitriol, or alkaline solutions.

Third, that, when necessary, these scrubbers should be supplemented with special purifiers, as hydrated oxide of iron, hydrate of lime, &c.

Fourth, that organic vapours and sulphuretted hydrogen and empyreumatic matters should be conveyed to the furnace fire and destroyed. In carrying out this part of the process it is necessary that all steam should be condensed from the vapours by cooling them thoroughly before they reach the fire, as otherwise the fire is apt to be put out by them. The fire which is best suited for this purpose is that which is actually used in manufacturing operations, as special fires are very likely to be neglected; and the best place for the entrance of the noxious vapours is at the back of the ash-pit immediately under the fire bars, as by this means a draft is secured (by closing the ash-pit), and the vapours are made to pass through the glowing coals of the fire.

Fifth, all offensive materials should be brought to the works, or carried away from them, in properly constructed carts or tanks, which can be closely covered; and all such material when stored at the works should be kept in close tanks or chambers, ventilated, when necessary, to the scrubbers or furnace fire.

Lastly, the whole of the operations should always be managed with care and attention to details—there being no neglect of the sound condition of every part of the plant or working apparatus.

With these precautions, which are by no means unreasonable or impracticable, the manufacturer of offen-

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

sive products might generally so conduct his operations as not only to protect the public from annoyance, but also to secure his own interests by preventing unnecessary waste.

It will be observed that I have not dealt with the question of nuisances from the slaughtering of cattle, &c., as this has already received attention from the Society, through the labours of our colleague, Dr. Dudfield; in fact, our recommendations in this matter have been accepted by the Metropolitan Board of Works.

In conclusion, I trust that I may soon be able to find time for a further treatment of the subject by describing the nuisances which arise from the second and third causes alluded to at the beginning of the paper.

NOTICES OF BOOKS.

Milk in Health and Disease. By A. H. SMEE. London: Printed by E. Newman.

THIS little work seems to have been written in order to throw discredit upon the process now usually adopted in the analysis of milk. As such it will doubtless be welcomed by all fraudulent dairymen, and not less by certain unscientific members of Parliament who have taken upon themselves to adjudicate on the "competence" of chemists. Now, we shall not assert that the process used in milk-analysis is absolutely perfect and incapable of improvement, but it has been adopted after an amount of careful experimental verification which may well be called enormous. Independent and eminent chemists up and down England and Ireland, in Sweden, in America, and elsewhere agree as to the practical uniformity of the "solids not fat," and consider the standard adopted by the public analysts to be well within the mark. Under these circumstances Mr. Smee must surely admit that the few dissentient statements must be received with grave suspicion. He seems to forget the real nature of the question put to public analysts concerning samples of milk laid before them, and to make, or rather insinuate, a charge of incompetence because they do not give further information. Thus, in summing up his results, he states—"That the methods now employed by public analysts are not sufficiently delicate to detect the minute physiological changes which may at times take place in so complex a fluid as milk." To this it is sufficient to reply that the public analyst, as such, has nothing to do with "minute physiological changes." He is simply asked, is such and such milk adulterated? Again, Mr. Smee has been informed, though upon what authority he does not state, that two tons of borax are sold annually for the purpose of adding to milk. This is a sufficiently loose statement. Where are the "two tons" sold? In all Europe, in England, or is this dose reserved for the especial use of London? He then resumes, that although so large a quantity, is sold annually to be added to milk, it is extraordinary that no analyst has recorded its presence and no prosecution has been instituted against offenders. *This fact has a tendency to throw discredit upon the analytical evidence upon which convictions for milk adulteration have been secured (!)* Let us now look a little more closely at these charges. Two tons may sound a large quantity; but it is not 13 lbs. daily. Divide this equally among all the milks sold in London, and it will make but an infinitesimal addition to the residue of ash in each case, especially if we remember that borax contains 47 per cent. of water. Or if it is only used by a few dealers, and has been but recently introduced, it is perfectly possible that no sample containing borax has come under the hands of a public analyst. If present, it would show itself by an increase in the proportion of ash to the other solids. But if the ordinary process of milk—without special examination of the ash—has failed to detect borax when present, the error tends to let rogues escape

scot free, and not, as Mr. Smee most unjustifiably insinuates in the passage we have italicised, to the wrongful conviction of honest men. New methods of adulteration will, of course, spring up, and the skill of chemists will be tasked to keep pace with the depraved ingenuity of pushing tradesmen. But are we to censure the chemist who devised the process "commonly used by public analysts" for not giving special directions for the detection of a sophistication not then, if now, in use?

The variation in the total solids found in the milk of individual cows, even if well authenticated, is, as far as the detection of adulteration is concerned, not a point of great moment. What is the probability of a pint of milk as supplied by any dealer being entirely composed of the milk of one animal? We are struck with the small amount of fatty matter in the milk of short-horns, as shown in Mr. Smee's tables. This confirms the low estimation in which the breed was held in Lancashire and Westmoreland.

We find in this work two references to an alleged outbreak of enteric fever at Marylebone in 1873, which is said to have been "traced to milk obtained from a particular farm, the dairy utensils being washed with water contaminated with fever poison." Unfortunately, if we turn to the reports of the Registrar-General, we find that at the time of this epidemic the number of deaths from typhoid fever in Marylebone, instead of being in excess, was below the average for the season of the year. The man whose dejections are said to have poisoned the well died not from typhoid but from disease of the heart, as certified by two legally qualified medical men; and though the water was used for domestic purposes in the village, no outbreak of fever could be traced there.

But whilst we think that Mr. Smee is grievously astray in his remarks on milk analysis, we are much interested with the results he has obtained with the milk from cows fed upon sewage-grass. "The milk derived from the cow fed with sewage-grass went putrid and stank after thirty-six hours. The butter from sewage-grass fed milk became rapidly rancid compared with milk from cows fed on ordinary meadow-grass. The cream from ordinary grass required 35 mins., $1\frac{1}{2}$ hours, and $\frac{3}{4}$ hour to churn, and the butter was firm. That from sewage-grass required $1\frac{1}{2}$ hours, $1\frac{1}{2}$ hours, $2\frac{1}{2}$ hours, and the butter was soft and yeasty. These experiments were repeated with the milk from the same individual cows, and with other cows, but the results obtained were practically the same." The author also finds that hay made from sewage-grass when kept in a vessel of water in a warm place, sent up in a few days putrid fermentation, whilst ordinary grass treated in a similar did not. This agrees with the statement of Lefeldt that he had found unassimilated sewage-matters (Kloaken-stoffe) in the stems of grass from sewage-irrigation farms, and with our own observation that fish from rivers contaminated with sewage, *e.g.*, certain parts of the Thames above London, pass into putrefaction with exceptional rapidity. Mr. Smee's remarks ought to furnish a theme for meditation to certain enthusiasts of irrigation. There is something exceedingly appropriate in such a blow to the pet scheme of the late Rivers' Pollution Commissioners being administered in a book solemnly dedicated to the Chemist to the Commission.

CORRESPONDENCE.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

SIR,—Dr. Frankland has already expressed his obligation to your correspondent for calling attention to the experiments on sulphate of quinine described on page 505 of the Appendix to the Sixth Report of the Rivers Pollution Commission. Your correspondent will now call attention

to an experiment on "Fresh Urine," described on page 9 of the Report, where fresh urine is represented as containing carbon and nitrogen, in the ratio of 0.99 of carbon to 1.00 part of nitrogen. This ratio cannot be correct, inasmuch as urea (the main organic constituent of urine) contains carbon and nitrogen in the proportion of 0.43 of carbon to 1.00 part of nitrogen.—I am, &c.,

J. ALFRED WANKLYN.

TESTING ALKALI.

To the Editor of the Chemical News.

SIR,—During the last twelve years I have tested some thousands of samples of soda-ash and caustic, against the Liverpool analysts. My experience is that their tests of high strength caustic are *perfectly correct*, as based upon the 32 equivalent; their returns for soda-ash, however, are nearly always 0.70 per cent too high.—I am, &c.,
SODA.

CHEMISTS AND THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—It has been pointed out (CHEMICAL NEWS, vol. xxxii., p. 251) that "perhaps degrees and diplomas may come, before long, to be judged according to the personal merit of their holders," and that men "must be estimated rather by their researches and writings."*

These views at least derive some weight from an incident that occurred at the meeting of the Chemical Society on the 2nd inst., when among the certificates read for the third time was one of E. A. Sturman, M.A., Ph.D. (Rostock), &c., Principal of Queen's College, Penge, Sydenham. His certificate was signed by three Fellows, from personal knowledge, who, on consulting the List of Fellows of the Chemical Society, we find to be all Doctors of Philosophy.

Mr. Charles T. Kingzett, in calling the attention of the Society to this certificate, read from *Figaro* of Nov. 24th the following passage:—"Professor Sturman, LL.D., of Packington College, 145, Packington Street, Islington, Secretary to several Foreign Universities, who prepares candidates by correspondence for B.A., M.A., Ph.D., LL.D., D.D., &c., and for legal and medical qualifications, &c., and who obtains titles of Chevalier and medals of Honour, &c., has, we are informed, done a roaring trade." In making this quotation Mr. Kingzett stated that he did not for one moment assert the identity of the candidate whose certificate had been read with the Dr. Sturman referred to by *Figaro*, but that, until the Society should be furnished with proofs of the non-identity, he considered it to be the duty of every Fellow present to vote against this candidate.

Any doubt that may exist as to identity would seem to be dispelled by the statement made to us by one of those Fellows of the Chemical Society who signed Dr. Sturman's certificate. This statement was to the effect that the candidate was the Dr. Sturman of Packington College! But the three gentlemen who signed Dr. Sturman's certificate, from personal knowledge, can surely give the necessary explanation.

Let us pass on from this matter to the general question of the elections at the Chemical Society.

The Chemical Society was founded for "the general advancement of chemical science," and it includes in its List of Fellows nearly all the best chemists in Great Britain; and that it prosecutes good work, and in a measure represents chemical science in England, is undoubted.

Now we do not consider the calling of a chemist and druggist, or of an apparatus-maker, or of a schoolmaster, to be incompatible with a knowledge of chemistry, but we do object to the acceptance of these callings as chemical qualifications. And supposing a man can adorn his name

with twenty-letters, what proof does this fact afford of his ability to advance chemical science? We do not hesitate to say that there are few men who are, at the same time, eminent theologians, good geologists, men of letters, and good chemists; and, as a rule, it may be taken that a man who boasts several professions is not worthy of all.

In short, we submit that no qualifications should be accepted at the Chemical Society but chemical qualifications, and it may be relied upon that if a man has them he will take care to state them upon his certificate.—I am, &c.,

A CHEMIST.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 22, November 29, 1875.

Memoir on the Organic Elements regarded as Electro-Motors.—M. Becquerel.—It appears, from the author's researches, that the interior of a muscle is negative, which indicates that there is oxidation in the interior and reduction at the exterior, and that all organised bodies appear formed of—so to say—an infinite number of electro-motors which intervene probably in the phenomena of nutrition.

Examination of a Wood Petrified with Subcarbonate of Lime found at Bourbonne-les-Bains.—M. Chevreul.—What is called petrification of a solid of organic origin comprises two distinct epochs when it is complete,—that is to say, when nothing more of an organic nature remains in the petrified solid. The first complete epoch comprehends the total occupation of all the interstices, all the pores of the solid by matter dissolved in a liquid. The second epoch comprehends the duration of the total disappearance of the organic matter itself, and its replacement by an inorganic matter which has penetrated it in a liquid state. It is this latter matter which represents the form of the organic matter.

Thermic Researches on Phosphoric Acid.—MM. Berthelot and Louguinine.—M. Thomsen, having repeated the experiments of Graham in 1869 (*Poggendorff's Annalen*, cxi., 90 and 94), concluded that phosphoric acid was not a true tribasic acid, but rather a bibasic and triatomic. The authors, having re-examined this subject, conclude that the three equivalents of base successively united with phosphoric acid are combined in different manners, the first being comparable to the base of the nitrates and chlorates, the second to that of the carbonates and borates, and the third to the base of the alkaline alcoholates.

Observations on the Composition of the Arable Soils of Auvergne: Importance of Phosphoric Acid as regards their Fertility.—M. P. Truchot.—After examining the granitic and volcanic soils of Auvergne, the author concludes, with M. P. de Gasparin, that phosphoric acid rather than potash gives the measure of the fertility of a soil.

Contraction Produced by Interrupting the Current of the Battery in the case of Unipolar Excitement of the Nerves.—M. A. Chauveau.—This memoir would be unintelligible without the accompanying illustrations.

Crystalline Sulph-hydrocarbide obtained from the Interior of a Mass of Meteoric Iron.—Lawrence Smith.—In the study of meteoric graphites, with which the author is engaged, an observation made during the combustion of graphite in oxygen led him to suspect the

* Mr. Morgan has since informed us that he obtained his diploma after passing the usual examinations at Giessen.—Ed. C. N.

presence of a hydrocarbide like that discovered by M. Woehler in the meteorites of Kaba and Cold Bohevelde, and subsequently by Roscoe in the meteorite of Alais. On treating graphite obtained from the interior of the meteoric iron of Sevier Co., Tenn., with ether, he obtained a small quantity of acicular crystals, of a peculiar odour, mixed with some small rounded points. The experiments made upon these crystals demonstrate their identity with those described by Prof. Roscoe before the Philosophical Society of Manchester, February 24th, 1863. L. Smith proposes for this body the name Celestialite.

M. Reimann's Farber Zeitung, No 45, 1875.

This number contains a paper on the uses of sulphate of magnesia in dyeing, under which the writer points out that it is sometimes added to a dye-beck to raise its boiling-point. Sometimes it is often used to form by double decomposition sulphates of certain tinctorial bases, especially the aniline colours, which are then more easily fixed upon the fibre than the corresponding hydrochlorates. Sulphate of magnesia is also added in woollen-dyeing to certain colours which are to bear fulling. A. Frank, of Stassfurt, points out that cotton goods are sometimes weighted with sulphate of magnesia to the extent of 53 per cent. This treatment he denounces as fraudulent, but it is defended by M. Reimann, who, however, protests against the use of chloride of magnesium for the same purpose, as being injurious to the fibre.

There are further receipts for a grey, and a black, on silk garments; a blue on half-woollen tissues; a dark blue for loose wool, fast and fugitive; for printing a grey, red, and a violet on half-silks; and for a black on linen yarn.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, September and October, 1875.

The only chemical notices in this issue are taken from the *Comptes Rendus*.

Les Mondes, Revue Hebdomadaire des Sciences, No. 13, November 25, 1875.

Here we find a notice of the life of "Anne Toussainte de Volnire, called the "Saint of Néant."

In a note on guano, we read that the accumulations of guano on the Chincha Islands are generally considered as composed of the excrements of sea-fowl. In reality they consist of two portions, differing both in the manner and the epoch of their origin. The upper layer, much the less considerable, is formed of the excrements and dead bodies of birds and of seals, which at present inhabit the islands in question. The lower bed has been formed in præhistoric ages from the excrements of birds which have fallen to the bottom of the sea, of which they inhabit but a limited portion. The strata thus formed have been subsequently upheaved.

An article of nine pages, headed "Natural History," should rather have been entitled an essay on the operations of Catholic missionaries in China and India.

The paper on "Acetimetry," by MM. O. Reveil and Saleron, has been already noticed.

M. Maumené very justly condemns Baumé's hydrometer.

M. Durand, of Blois, proposes to preserve eggs by coating them with silicate of soda.

The papers on the electrolytic formation of aniline black, or on the distinction between artificial alizarin and extract of madder, as existing upon printed calico, have already been noticed.

From the *Transactions* of the Academy of Sciences at Stockholm for 1875, No. 3, p. 83, is taken an account of rainbows intersecting each other, as observed by M. Gumœlius at Nya Kopparberg, June 19, 1874.

December 2, 1875.

The editor gives the rules of the Scientific Society of Brussels, a recently-formed body, whose object is to cause science to "continue the series of his glorious advances without ever rising in insurrection against the faith, with this profound conviction, that every fact, every theory in contradiction with the faith is necessarily false (*tant pis pour les faits!*), and consequently unscientific." The 10th article declares that the Society "shall never permit any attack, even if courteous, against the Catholic religion or the spiritualist and religious philosophy."

The next article contains the text of the law on the "liberty" of superior instruction in medicine. This is followed by a paper, entitled the "old and new faculties of medicine, which occupies ten pages, and does not possess the slightest scientific interest. The only chemical matter in this issue is a reproduction of the memoir on ozone, read by Dr. T. Andrews before the Royal Society of Edinburgh.

Moniteur Scientifique, du Dr. Quesneville, December, 1875.

Products of the Decomposition of Castor Oil.—M. E. Neison.—Translated from the *Journal of the Chemical Society*.

Theory of Luminous Flames.—M. Charles Heumann.—A flame may be rendered non-luminous by reduction of temperature; by dilution with inert gases; and by energetic destruction (oxidation) of the luminous matter. The luminous power may be restored by a supply of heat; by the elevation of the temperature of the flame by heating the gaseous mixture, or the inert gas alone, in a tube of incandescent platinum before its ignition; and by rarefying the oxygen with an inert gas.

Account of Chemical Progress.—M. A. Macquet.—This paper includes a notice of an elementary work on inorganic chemistry by M. E. Grimaux; a translation of two memoirs on paraffin, from the *Journal of the Chemical Society*; a note by M. Chautard on the spectrum of chlorophyll; and a memoir by M. E. Bourgoin on the identity of the bromated derivatives of tetrabromide of ethylen with those of the perbromide of ethylen, noticed long ago.

Facts Relative to the Study of the Polyatomic Alcohols, properly so-called.—M. Lorin.—Already noticed.

Note on the Determination of Caffeine.—M. A. Commaille.—Already noticed.

Separation of Cholesterin from Fatty Matters.—A. Commaille.—The author saponifies the fatty matter with caustic soda, and after cooling and dissolving the saponaceous mass in water, agitates with ether, which on evaporation deposits cholesterin in flakes.

Central-Blatt für Agrikultur Chemie, Heft 10, October, 1875.

Amount of Water Evaporating in the Open Air.—C. von Sonklar.—The amount of evaporation at different seasons of the year depends primarily on the temperature, but in an inferior degree on the amount of atmospheric moisture.

Influence of Forests upon Climate.—L. Fautrat.—Taken from *Comptes Rendus*.

Influence of Manuring with Superphosphate upon Quality and Yield of Hay.—Dr. J. König.—The author finds that a dressing of superphosphate improves the quality and quantity of hay produced on barren irrigation-meadows.

Influence of Limestone on the Distribution of the so-called Calcifugous Plants.—Ch. Contejean.—Taken from *Comptes Rendus*.

Mineral Constituents of Lucerne.—P. v. Gasparin.—Former analyses of the ash of lucerne showed a very high amount of soda. The author, however, finds only 0.915 per cent, though the filtered subsoil water contained 50 m.grms. in a decalitre.

Presence of Copper in Juniper Liqueur, Brandy, and Dung.—Dr. A. Petermann.—The author traces copper in juniper- and corn-spirit, and even in the dung of cattle fed with the spent grains from the distilleries.

NOTES AND QUERIES.

Synthesis of Tannin.—I have made many attempts to convert gallic into tannic acid by digesting with arsenic acid as described in *Chem. Soc. Jour.*, vol. xii., p. 269, but so far without any success. I have digested with large and small quantities of arsenic acid in aqueous and alcoholic solution for four or five days together at boiling temperature, but have been unable to detect a trace of tannin even with acetate of copper and ammoniac carbonate, while abundance of gallic acid has crystallised out on cooling. If any chemist who has succeeded will point out my source of failure I shall be exceedingly obliged.—HENRY R. PROCTER, Preston, North Shields.

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